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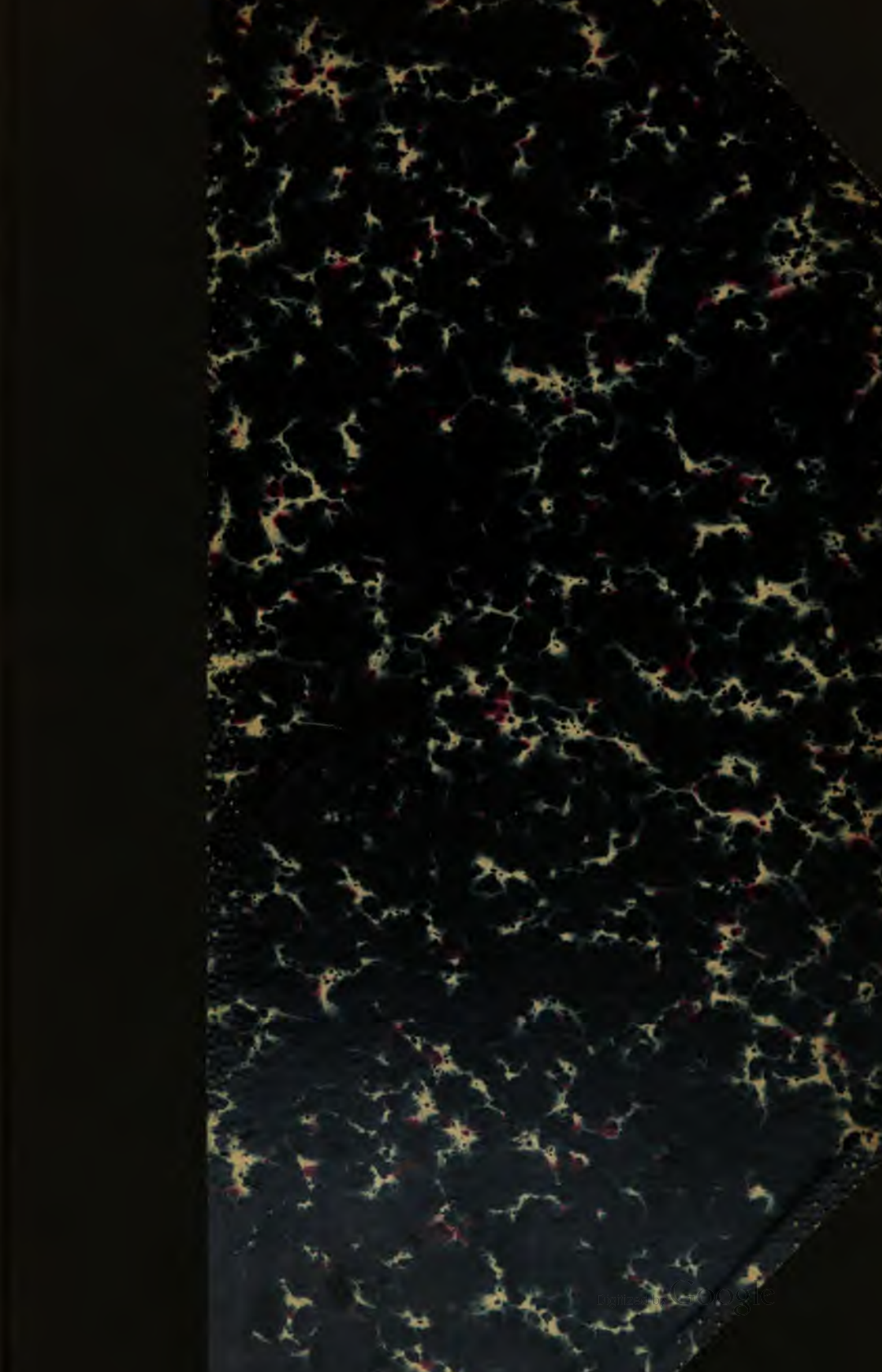
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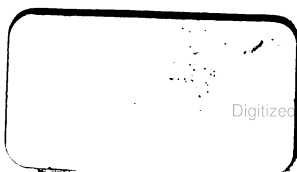
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Studies in Diatom Biology.

By K. M. CUNNINGHAM,
MOBILE, ALA.

During the month of November, 1895, I had an opportunity of securing a very interesting gathering of living diatoms under the following conditions. On one of my excursions I incidentally noted that the surface of a ditch used for transporting saw logs through a marshy flat, was covered with a thick and uniform layer of greenish scum, and that it was accidentally banked up at the point, by a boat paddle arresting its passage along the ditch. The winds were driving further supplies of scum to the obstruction across the ditch. A momentary inspection indicated that there was a very rich accumulation of diatoms. I secured a pint or so of the material for treatment and study. The chief or most numerous form occurring in the gathering was *Nitzschia scalaris*, which species, as is well known, is among the largest of the prism-like forms commonly encountered all over the globe, and is associated with fresh or brackish waters. By availing myself of the aid of this special form in its living state, I was enabled to prosecute some studies tending to give additional importance to the hypothesis that this diatom belongs biologically to the protozoa rather than to the plants. I shall indicate by what line of reasoning I venture to present this view to the attention of those who are interested in biological studies.

As a primary fact, we may assert that when a portion

of the material is gathered in its densest state, it is introduced into a suitable bottle, and the diatom contents are allowed to distribute themselves in the water. It is soon evident that many of the motile forms in the bottle are attaching themselves to the inside surface of the bottle and continue their motions incessantly in any chance direction. If now while having a bottle of this kind under inspection, as simple an apparatus as a common five cent lens, of a quarter inch focus, will enable anyone to follow the motions of the large *Nitzschia scalaris* in its wanderings while in contact with the glass surface. This fact alone would be *prima facie* evidence of its having some organ adapting it to auto-locomotion, and that in a particularly striking manner. The same simple aid will also show that if one extremity of the prismatic body of the *Nitzschia* should become detached by shaking from contact with the side of the bottle, leaving but one end adherent, the end in contact still may have sufficient motive power therein to propel itself along the glass, and when a *Nitzschia* is thus moving around, it can be followed for hours, if the observer is so disposed.

This is the simple character of an initial study that might have been made by Leewenhoeck in his day, with credit to himself for whatever his observing mind might have noted in relation thereto. If now, however, the conditions under which we view the *Nitzschia* be modified, we may find a new series of phenomena that would have been totally overlooked in the experiment noted above. If during the study we transfer a dip of the diatom material covering some of the *Nitzschias* to a glass slip, and cover the same with a cover glass and view the living frustules with the aid of a 1-6 objective, then the peculiarities of locomotive and motile effects may be very readily observed. A close study will verify the fact that the *Nitzschia* has a distinct movement; not merely of progression or change of place in a rectilinear path, but

also that the entire epidermal coat may be actively engaged in gathering up any character of minute mineral or other debris along its path. Such particles as become attached, are independently moved from numerous centers of vital action. This is as if the epidermal surface at any given point had a retractile and contractile power, independent of any other given point of vital action along the frustular surface. The motile functions consist of the power of transporting small mineral particles such as sand grains and vegetal debris for appreciable distances along its edges or surface, and of rejecting them and substituting new particles. The particles may be jerked up at any point and carried indifferently in a positive or negative direction from the point of attachment, until these particles are replaced by new ones. It should strike any observer who may verify these phases of action that such phenomena point to a more complex cilia-like function than that which may be noted in the ciliary fringes of an oyster or clam. The latter cilia motion lashes and drives the particles in a general direction or current. The complicated system of moving particles can also be followed in its interminable variations as long as it may suit the convenience of the observer to change the specimen of *Nitzschia* under observation, on account of its relatively conspicuous size. *Nitzschia scalaris* is a very satisfactory species in which to study the character of its vital movements.

The internal frustular contents present an abundance of globular bodies of varying sizes which have a constant independent motion among themselves, that is, their juxtaposition is seen to be constantly changing when very carefully noted.

Nitzschia scalaris when viewed under a power of 500 diameters is longer than any other of the North American specimens of the bacillar forms, and therefore can be

observed with ease in verifying what is said herein in reference to its intricate motile powers.

In further studies of *Navicula nobilis* and *firma*, with the view to verifying the results obtained by a former contributor on the subject of the movements of diatoms, I made use of methyl-blue to differentiate the epidermal covering or mantle, by the following methods. From a rich gathering of living *Navicula nobilis*, *firma* and *Surirella biserriata*, and other forms, I transferred a drop to a slip, and observed them with a $\frac{1}{2}$ inch objective. By this means I was enabled to note that as many as twenty forms of *N. nobilis* and *firma* could be found in parallel contact at one and the same time, gliding back and forth in contact with each other, somewhat after the manner that colonies of *Bacillaria paradoxa* move at times. While having this special gathering under study in order to note the character of the epidermal envelope, it became relatively easy to note the amount of separation between two or more touching frustules of the surrounding transparent layers. Now, admitting that the external layer, if it exists at all, must have the character of an albuminous substance, such as the white of an egg, the substance ought to coagulate under a boiling temperature, and take on an altered or fixed state the same as the white of an egg does when boiled sufficiently. By shortly drying such a slide of living diatoms over a students' lamp flame, and completing the mount with thin balsam, we find that the epidermal covering has been changed to a practically impervious envelope. The thin balsam failed to penetrate many of the frustules during a period extending over months. The slide on examination periodically showed the frustules to be filled with air, and the shrunken or contracted threads of endoplasm still showed a strong greenish tint in the air filled spaces. On the contrary, it is well known that, in acid-treated diatoms of like character, there is almost an immediate ex-

pulsion of air from the frustule, and a substitution of the balsam in the air spaces. If these phases of study are accurately construed, we have a demonstration of the presence of enveloping substance on the exterior of the silicious frustules without resorting to staining tests for a like purpose.

Continuing this investigation, I made an attempt to differentiate the protoplasmic mantle with the aid of dyes in order to verify an experimental study recorded several years ago by C. Onderdonk and published in this journal. While I failed to duplicate what was stated therein, I found a wide range of interesting phenomena throwing light on the structure of the living diatoms. By placing a drop of water with numerous large *Navicula* on a slip and covering it with a $\frac{1}{4}$ inch cover glass, and then placing in contact with the edge of the cover-glass, a minute grain of crystalline methyl-blue, the dye was speedily diffused from the edge of the glass and passed slowly across the fluid field. Then it was a very easy matter to steadily observe for protracted intervals the action of the dye, as its influence reached the living frustules. For example, the stain was absorbed by the frustule both inside as well as outside, some time before it was perceptible in the thin layer of liquid; and more markedly absorbed by the internal protoplasmic granules when the dyeing action became more evident. The evidence of a strong irritation on the part of the frustule is readily observed as it quickly loses the power of direct axial motion and swerves irregularly and spasmodically at alternate ends, unable to advance in its normal manner. It may even spin around in its own length, the power of controlling its normal traveling motion being in a manner paralyzed. At least this would be the probable interpretation, that any observer would identify with an irritating toxic substance acting on organisms having a determined or even conjectural nervous system

or a cellular structure to which poisons would be deadly in their effect. The process of encroachment of an aniline dye and its lethal results may be studied with equal interest in the smaller *Naviculæ* as in the larger. There is the same activity of irritation and arresting of locomotive power, and finally the death of the bioplasmic power, whether inside or outside of the frustule. For those who could find interest in the death struggles of vertebrate animals, as seen in the case of Spanish bull fights, or the asphyxiation of dogs during the canicula, might be found plenty of mental excitement in following the death throes of a diatom from start to finish, under the method of drowning in a weak aniline bath.

After having had sufficient familiarity with the phases leading up to the extinction of the life process of a series of living diatoms in the field of the microscope, it would perhaps be repugnant to the student to admit that he has been witnessing vital phenomena characteristic alone in its nature of plant or vegetable life. These forms have heretofore been deemed too insignificant to warrant for them a place among the Protozoans; the fundamental or simplest class of animal life which modern science has so far been able to trace.

By varying the dyeing tests with a substitution of common violet writing ink, I found features not observed during a lengthy study with methyl blue. When the violet stain reached the *Navicula*, I noted that what appeared to be a sort of vermicular festoon was formed from the mantle or surface of the frustule, and the vermicular shreds broke off and drifted away leaving some strands adhering to its sides and small villous tufts at each end of the frustule. This seemed to represent to me, what C. Onderdonk described as the mantle expanding or crinkling up like folds of cloth around the edges of the frustule. Apart from this, I found nothing that I could identify as that which he stated he had repeatedly verified in re-

gard to a differentiation of the mantle (ectoderm) enveloping the navicular forms by the use of methyl green. I had stained slides richly strewn with living diatoms upon which I made my observations and, on drying, the frustules were examined superficially with condensed light, and otherwise, only to find that the frustules gave off the metallic sheen of the dye, with the sculptural markings showing clearly; but the frustules were surrounded where in contact with the slip by a crystalline fringe of the methyl blue. They then simulated what might be construed as a sort of ciliary projection. This makes any deduction with reference to the mantle from this mode of study an unknown quantity. The essential points of C. Onderdonk's paper in relation to the mantle of the diatom, and a conjecture touching the seat of the vital function controlling its motile power, were adopted by Wolle in his *Diatomaceæ of North America*. Therein the marvelous phenomena of the diatom's power to handle and rush grains of sand, as often as its necessities may require it to do so, is entirely overlooked. I allude to the portion of the work upon the "Motion of Diatoms." This function of the diatom to gather up and transport mineral particles energetically, is one that can be readily verified with the aid of a 1-6 objective. No one need miss it. The study involves no difficulties.

W. A. Terry, an expert student of the living diatom, has frequently made allusions to the peculiarities of motion observed by himself, and from sources of supply that I have never had an opportunity to inspect, he has recently put on record the statement that some of the very large living *Amphiprora* observed by him might pass for vegetables but never for plants. As it was not his object to seek for data to establish the Protozoan nature of the Diatom his observations were not sufficiently critical to contribute to a formulary of expression adapted to animal biology. He had incidently noted that a vigorous

diatom had tractive power sufficient to push or pull a mass of obstructing matter equal to its own bulk or even greater. In connection with these remarks, it may be proper to relate that he has recently been cultivating or growing the living forms and kindly offered to mail to me a culture sample. But we feared that they would not arrive in good condition if sent.

Acting on a suggestion derived from H. L. Smith's work in relation to the action of alkali on the protoplasm of the living frustules in an experimental way, I found that if a mounted slide of living diatoms was immersed in strong white soap solution and set aside for about twenty-four hours, all the frustules containing the living endoplasm were burst asunder into numerous small fragments, and the greenish contents were driven out and distributed in rills over the slide. This also showed that sutural lines are weak points in the frustural box.

In an attempt to clean a considerable quantity of material, from which the studies of *Nitzschia scalaris* were made, by boiling in a pearline solution, the result showed that the recent species had become badly distorted by a partial solvent action, and a softening of the siliceous. This I had never previously noticed in acid treatment, but I had been aware of the necessity of using the alkalies cautiously in one stage of the cleaning process.

Those who undertake to solve for themselves the mysterious cause of motion in the diatoms, will be confronted with a species of phenomena of the most puzzling interest. If the living diatoms have been retained in the same bottle of water for a period extending over three days or more, the study will be complicated by the growth in the water of several kinds of spirillum, which are apt to colonize around the edges of all diatoms. When this is the case, it may so happen that when a large *Navicula* is being closely studied in the field in expecting to detect some characteristic of motion, the mind will suddenly be

attracted by lightning-like flashes of little specks with spiral and vibrating movements that dart from the ends and sides of the moving diatom. The illusion at first takes the form of an idea that the diatom is discharging nettle-like threads, and as quickly retracting them. Should the mind get caught under this spell once, it will be a material duration of time before the observer, fascinated by this illusory appearance, can dissociate his mind from the idea that what is seen is not a part of the vital function of the ectoderm of the diatom, and properly refer this action to the parasitic colonies of *Spirilla*, which seem to be living in symbiosis with their host the *Navi-cula*.

How to Make and Stock a Fresh-water Aquarium.

By REGINALD A. R. BENNETT, M. A. (Oxon).

CONSTRUCTION OF THE TANK ITSELF.

When I saw the above announced as one of the subjects for the forth-coming competitions, I at once made up my mind to send in a series, and hope for the prize, for the "E. M." has been an old friend to me for many a long year, and I have all the back volumes from the very beginning arranged on my bookshelf. I cannot truly say that I took it in from the beginning, the first numbers having been presented to me some years afterwards; but, no doubt, I should have taken it when it first came out had it not been for the fact that the first numbers appeared during the same year that I myself burst upon this lower sphere, and at that time I was more interested in the maternal lacteal fluid than even in the advance of science. However, later volumes have been of invaluable service to me, and this is by no means the first time that I have written in "Ours," though not before in the form of an article.

As I see that there has been some discussion as to the

capabilities of the winners of these prizes, I will here state that I am writing this series from a personal experience with the matter, having myself practically kept fresh water (and I may add, also marine) aquaria for a good many years. The system and details of working laid down are, therefore, the result of practical knowledge.

I do not think it is necessary, in the pages of this journal, to enter very deeply into the science involved in the maintaining of an aquarium. Most of its readers are, doubtless, aware of the compensating action of the various animal and vegetable organisms, whereby the balance of life is kept up, and the fishes, etc., supply carbonic-acid gas which the plants, if in good health, utilize in the formation of their tissues, transforming it into pure oxygen, which being dissolved by the water, is taken up by the fishes and other animal organisms to be utilized in the aeration of their blood. From a consideration of these facts, it naturally follows that in our aquarium we must have a supply of healthy plants to manufacture the oxygen required, if the fishes are to be kept for a long time in a satisfactory state of prosperity. Given the suitable conditions, and it is perfectly possible to keep the aquarium for many years without changing the water, or moving animals or weeds. In practice I have done this myself, though if the aquarium keeper has a sufficiency of time on his hands, I think an occasional turning out and cleaning is more likely to produce a pleasing effect on the eye than leaving the tank to itself for the longest possible time. A great deal, however, depends upon the amount of water employed.

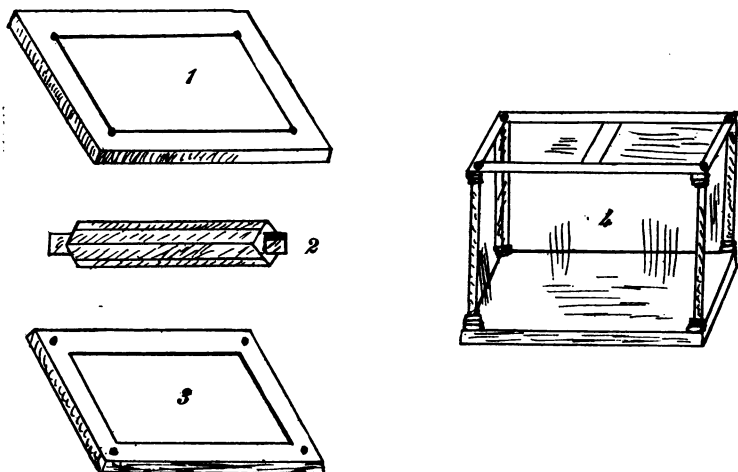
In setting up the aquarium, the first thing must necessarily be the manufacture of the tank itself. And here we are confronted by the question of the most suitable dimensions. I do not think, in the case of a fresh water-tank, the depth is a matter of very great importance,

as it certainly is in the case of a salt-water one. The amount of water it is to hold must, of course, settle its actual size; but, as a rule, it should be said that no tank should be deeper than it is wide, and its length should be about twice as long as its width. To descend to particulars: to hold 12 gallons the tank may be about 27 in. by 16 in. by 14 in. deep. One to hold up to 20 gallons will be about 36 in. long by 22 in. broad by 18 in. deep.

As to the actual structure of the tank, this, of course, depends very much upon the taste of the maker. Personally, I think the plainer the tank is (within limits) the better. It is the fishes and plants, etc., that are the objects of attraction—not a gorgeously ornamented tank. For this reason I look upon all ornamental “tops,” brass fringes, etc., round the edges, and carved images on the pillars, etc., as abominations. If the tank is to have a top it can be composed of two perfectly plain pieces of glass, each the width of the tank frame and rather less than half its length, thus leaving a little strip between them when they are placed in position, through which the air can get at the water. If the beetles, etc., show a disposition to get out the vacancy can afterwards be covered with a strip of perforated zinc. The glass is, of course, held in its place by fitting into a rabbet in the upper surface of the frame, in which it can lie.

The following will, I hope, be sufficiently explicit directions as to the actual manufacture of the tank for those who have never constructed anything similar before. The first thing to do is to make the bottom. For this I have tried plain wood, wood painted and varnished, and wood covered with glass and cement, and am decidedly of opinion that wood in any form is to be avoided. The best thing to use is a tolerably thick slab of *slate*, and taking my first dimensions of the tank as an example, I think for this the slab ought to measure about 29 in. by 18 in. by 2 in. thick. This allows of a width of an inch

all round, which is advisable, though not essential. In this slate, at a distance of about an inch from the edge all round, you have to make grooves with holes at the ends for the bottoms of the pillars, see Fig. 1. These holes should be about 1 in. in depth and the same in breadth; the grooves should be about $\frac{1}{4}$ in. broad and *at least* 1 in. deep. You now have to construct the pillars, which are made of hard birch wood—or mahogany will do—and are shaped as Fig. 2. The sides are, in my opinion, best square, but you can make them round if you prefer it. If square, the sides may measure 2 in. in breadth; if round, they ought to be at least $2\frac{1}{2}$ in. in diameter. The



ends are, of course, to be cut to a circle about 1 in. in diameter, or, better, shaped to accurately fit the holes made in the slate bottom. The part thus shaped will, therefore, be about 1 in. long, while the middle (square) part will be about 14 in. long. Down the middle of the pillars, on two sides, at right angles, are to be cut grooves about $\frac{1}{4}$ in. broad and *at least* $\frac{3}{4}$ in. in depth. Some may think my measurements unnecessarily large, but I have suffered so severely in bygone years from aquaria which leaked that I am quite resolved that if my measurements

are followed the English Mechanic tank shall, at any rate, be water-tight. To secure this desirable end, we have to fasten the pillars in their places with cement, and on this cement a great deal depends. It has to be elastic to a certain degree, so as to allow for changes of temperature and the consequent expansion and contraction of the glass and wood, it has to firmly resist the passage of the water, and it has to be one that will harden in a fairly short time, and that will not smell objectionable, as the living inhabitants of the tank are particularly susceptible to any foulness of the water caused by smells. The two best cements that I know of for the purpose, and which fairly fulfil the conditions required of them, are the following :—

Mix together one pint each of litharge, plaster of Paris, pure white sand, and two-thirds of a pint of freshly powered resin. These are thoroughly incorporated together by turning them over and rubbing them into one another with the hands, and the mixture is then made into paste with boiled oil and a little driers. It should be of sufficient consistency to dry pretty quickly, but not so stiff but that it will get into the holes and corners easily. If properly made this will not take long to dry; but you must leave the tank for a week at least, or more, before you attempt to stock it; and when you do so you must be quite sure, firstly, that the cement is really hard, and, secondly, that the smell has entirely departed. The second cement is made by melting in an iron ladle over a gas flame or lamp three-parts of pitch and one of gutta-percha. When they are thoroughly melted and incorporated together, apply liquid, and leave to set. This will not take so long as the other to dry, but it must be left till the smell has departed. It is impossible to lay too great stress on this matter. To use the tank too soon is not merely to court defeat, but to positively insure it. If the lead cement is used, it is advisable to cover it with

two or three coats of varnish, made by dissolving sealing-wax in methylated spirits of wine. When the pillars are fixed in their places, you can proceed to insert the glass. This is what is commonly called "32in." sheet glass, and is cut to exactly fit the grooves. The panes are firmly bedded in with the cement, and a light frame work is fitted on the top to hold all together. This framework is shown in Fig. 3. It is merely a frame about $1\frac{1}{2}$ in. in width and one-half inch in thickness. The top of each pillar, above the square part, is cut to this length and inserted in the holes at the corner, and small knobs are inserted at the corners to give the tank an ornamental appearance. If a glass top is wished for, the frame is cut with a rabbet about $\frac{1}{2}$ in. wide all round on its upper surface to receive the edges of the glass. The final appearance of the tank is shown in Fig. 4.

If the tank *has* to stand in a very sunny situation, I think it is decidedly advisable to provide some means or other of keeping out the superfluous light, as it acts most injuriously on the creature in it; and causes such a growth of confervæ on the sides that it is a continual nuisance to keep them clean. For this purpose I have always considered it best to have light shutters of thin wood constructed which will just go inside the frame formed by the bottom, top frame, and pillars, and outside the glass. This is done so easily that it requires no further description. I think this plan is desirable, because it allows of the complete closing of the sides of the tank in summer, when the weather is warm, and allows the shutters to be removed when it is desired to see any object close to the glass, or when the weather is cold during the winter. It is, therefore, much to be preferred to making the sides or ends permanently of slate.

In this series there is not space to describe further developments of the construction of the tank. It is also unnecessary, for any one, given the above details, can

easily construct any other form which his fancy may devise, or in combination with window conservatories, etc., by the use of a little brains. If the simple form of tank is used you will require a stand for it. This may have a top of its own, or the bottom of the tank may form the top. Anyhow, it is hardly necessary to say that it must, before all things, be firm and steady, as a collapse would be about as unpleasant a reverse of fortune as could befall the tyro aquarium keeper. It is preferable to use a table or stand with side bars between the legs about half way down.

When you are perfectly satisfied that the tank is quite dry, the cement hard, and that no smell is issuing from it, you can proceed to stock it, the method of which will be considered in the next chapter. But before placing anything in it, it should be most thoroughly cleansed by washing, and then rinsed with fresh water. After this, it must undergo a further process of purification by filling it with fresh water every few hours at first and letting it soak, then fresh water at intervals of a day, until the water is perfectly free from any smell, and especially from any prismatic scum on the surface, which is a sure indication of danger.—*English Mechanic*.

We learn from the French newspapers that M. Etienne will shortly introduce in the Chamber of Deputies a bill introducing the decimal subdivision of time.

Mr. C. G. Pringle has just returned from another botanical journey in Mexico, where, during the past season, he has secured about 20,000 herbarium specimens in the valley of Mexico and in Cuernavaca.

On account of his important work on Blood Test for cattle tuberculois, which has been published in many scientific papers at home and abroad, Dr. Ephraim Cutter, LL. D., has been invited to go to Africa to study the cattle Rinderpest, under the English government.

Surgical Sterilization and Sterilizers in Private Practice.

By EDWARD BOECKMANN, M. D.,

ST. PAUL, MINN.

Last May I delivered an address in Buffalo, N. Y., before the Association of Military surgeons of the United States, on "Asepsis in Military Service." This address, printed in the transactions of that society, considers at length the principles of sterilization, and gives at the same time a number of practical points just as applicable in operations in private practice as in operations in military service, for which reason I take the liberty to refer you to that for details.

With regard to the mechanical and chemic phases of surgical sterilization I have not much to add to or take from what I said last year. Supported by further experience, I can this year more strongly than last recommend the 1 to 2 per cent solutions of lysol at 120 degrees F. for combined mechanical and chemic disinfection of the operator's hands and the patient's skin.

Lysol possesses the undeniable advantage of being at the same time antiseptic and aseptic; it is a happy combination of a powerful disinfectant and soap (saponified cresol). It has the dissolving and penetrating properties of an alkaline substance. I know of no agent which at the present time is better adapted and more reliable in the disinfection of the skin than lysol, with the possible exception of alcohol, which certainly, with good reasons, receives the support of the world. Heretofore we have viewed alcohol in the light of a purely mechanical agent in the disinfection of the skin; this can no longer be successfully maintained. Alcohol is certainly a potent solvent of a great number of substances, sparingly, however, of fats. Alcohol must be viewed as a strong antiseptic, possessing the same significance for the skin as for anatomic preparations, taking up its moisture, pene-

trating and hardening them; a decided advantage over ether and turpentine, which certainly dissolve fat much more readily, but which are much less hydrophile. In order to obtain the greatest possible antiseptic effects of alcohol it is obvious that the skin must be dried, and strong, preferably absolute alcohol used, and the skin energetically rubbed for some little time. Since experience has taught me that the germicidal principle in lysol acts as a powerful antiseptic in the above mentioned strength, and as a prolonged friction with absolute alcohol makes my skin uncomfortably hard and brittle, I reserve the alcohol for the field of operation only.

The last act in my sterilization of the skin consists in impregnating it with sterilized lanolin. By this procedure it is my intention to restore to the integument its fatty protective, which has been removed to the greatest possible extent by the preceding chemico-mechanical disinfection; at the same time I aim to cover up the remaining, inaccessible bacteria. Lanolin, which is rich in bacteria, is sterilized simply by heating the anhydrous article over the fire in an enameled vessel to about 350 degrees F., whereupon it is either run into collapsible tubes (sterilized in boiling water), or mixed with four to five parts of anhydrous ether, as soon as it has cooled below the boiling point of the latter, and then put into patent stoppered, sterilized glass bottles. Lanolin contains a great many impurities not soluble in ether, and which sink to the bottom as a voluminous, white sediment; only the clear, yellow solution is used.

Provided with lysol, absolute alcohol and ethereal solution of sterilized lanolin, we are enabled to disinfect the skin, the most dreaded bearer of infection, as safely I imagine, as is possible at this time; and with as few and simple agents as can be demanded in operations in private practice.

While I practically occupy the same standpoint with

regard to chemico-mechanical disinfection, I must take up the thread where I dropped it last year, as far as thermic disinfection is concerned. It is quite natural that surgeons who occupy themselves with operations in private practice, not only are interested in portable sterilizers, but also prefer such as are constructed for combined boiling in water and its steam. Inventive geniuses have also from time to time, at short intervals, endeavored to satisfy this popular demand, but they have all, as far as I know, up to the present committed the error of constructing their apparatus for under-steam, which streams through the sterilizing chamber from below upwards; that is, a stream, which neither expels the air, nor penetrates the articles to perfection, and which consequently results in deficient condensation, besides leaving the articles moist. All sterilizers for streaming steam must necessarily be constructed for over-steam; the reasons being fully given in my article previously referred to. Personally I am not particularly in favor of combination sterilizers even when scientifically constructed, chiefly because boiling and steaming are different processes requiring an unequal time, steaming at least three times as long as boiling, not to speak of the time required to dry the dressings after sterilization. This entails the practical disadvantage, that instruments, for which boiling is our method of choice, suffer unnecessarily in the prolonged boiling, but, as this can be avoided, as I will explain shortly, I have in deference to the apparent popular demand revived the idea of a combination apparatus, which I described in the *Medical Record* a couple of years ago, and it is my improvement upon that apparatus which I take the liberty to demonstrate upon this occasion.

My combination portable sterilizer consists, as you see, of four parts: 1, the boiling plan; 2, the hood; 3, the instrument tray, and 4, the steam chamber.

The boiling pan is made oval for the sake of the instruments; convenient dimensions being four to five inches high, eight inches wide and sixteen inches long. Around the upper border on its outside is constructed a groove half an inch deep. The center of the bottom is perforated by a small opening, into which is fastened a tube, which extends to the level of the upper border of the pan;



under the opening at the bottom is placed the iron plate, familiar from my other sterilizers.

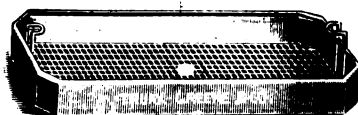
The hood, which fits closely within the outer lip of the groove of the boiling pan described above, and whose height is adjusted to that of the steam chamber, above which it extends half an inch, has a sloping roof, whose extreme top is perforated and fitted with a short tube or chimney. The hood is supplied with handles, and can be fastened to the boiling pan by means of two hooks.



The instrument tray is made to fit accurately within the boiling pan, the corners are cut off to allow for the legs of the steam chamber, the bottom is of galvanized wire and the frame is provided with two handles.

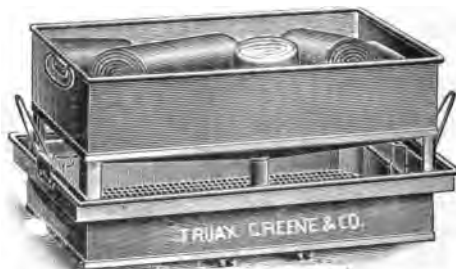
The steam chamber is of the same form and dimensions as the boiling pan; the chamber extends downward in a

sloping bottom, whose lowest, perforated point is on a level with the upper border of the pan; into this opening is fastened a tube, which fits accurately outside that described in the boiling pan and which is of the same length; at the juncture of the steam chamber and its sloping bottom is placed a diaphragm of galvanized iron; between this and the opening beneath is a small square tin plate; the chamber rests upon four legs, is provided with



handles and a sloping cover, perforated at the top underneath a handle.

Directions for use.—The boiling pan is filled with a sufficient quantity of water, care being taken to fill the groove at the same time; the hood is adjusted, and the whole placed over any good fire. While the water is heating, the instruments are arranged on the tray, and the dressing, etc., (previously washed) in the steam chamber; needles, drainage tubes, ligating and suturing



materials are put separately in a small metal box (sterile catgut is brought along in hermetically sealed envelopes). When the water boils, the hood is removed, the steam chamber put in, whereupon the hood is replaced with a cork in the upper tube. The steam will now ascend between the hood and the steam chamber to the top; the cork at the top and the water in the groove and in the

pan acting as locks, the steam is forced to work its way through the opening in the cover of the steam chamber into this, through the articles contained, and out through the tube in the boiling pan. In the course of a quarter of an hour the sterilization is completed; the hood is removed, also the steam chamber; the instrument tray is now put in, the steam chamber is replaced, the hood likewise, *but without its cork*. For the preservation of the instruments a little soda or soap has been added (lysol serves the same purpose.) In the course of five minutes the instruments are surgically sterile; during this time the steam will escape continuously through the open tube



of the hood, both that delivered by the water and that contained in the steam chamber; simultaneously a draught of hot air will enter the chamber from below, and when this is removed, its contents are not only sterilized, but also dry. A combined sterilizer of the dimensions above mentioned can, without difficulty, be transported in a suitable wooden case, and as the preparation and sterilization of the necessities is an easy matter, there is no possible excuse for resorting to mercantile antiseptic goods in operations in private practice. The surgeon who relies indiscriminately upon antiseptic wares, which he buys, is a dangerous man!

Articles adapted to sterilization by steam can safely

be transported to the place of operation in various ways, Bloch's method in double filtering paper being preferable; it is, however: always safer to sterilize on the spot, and, as only half an hour is required for the whole procedure, it is also practicable. In urgent emergency cases a surgeon ought never to be taken by surprise, and as time is valuable in such cases, he should always have on hand a supply of sterilized articles.

One more remark with regard to operations in private practice. I will most emphatically impress upon all surgeons, with the possible exception of those few who are masters both in surgical technique and in asepsis, to consider every wound at the end of an operation of some duration slightly infected, and therefore to combine their asepsis with a judical antiseptis. Thus I am in the habit of repeatedly dipping my hands during the operation in a weak, sterile solution of lysol ($\frac{1}{2}$ per cent or even less). The small amount of antiseptic which in this way is carried into the wound, I have yet failed to find objectionable, and I use lysol because it is at hand, and because it is alkaline like the fluids of the tissues. And when the operation is completed, I apply next to the wound an antiseptic dressing, not exactly the customary iodoform gauze, because its preparation requires extraordinary facilities, but antiseptic, and at the same time aseptic, hydrophile ointments. Anhydrous lanolin absorbs moisture greedily; it is first sterilized, mixed while cooling with 2 per cent lysol and run into tubes. A generous quantity is expressed over the wound, and over this the ordinary dressing is applied. Changing this dressing is unattended by the disturbance of the wound or the patient's comfort, as it does not stick like a dry dressing.

In the foregoing it has been my aim to dwell upon the most essential points in surgical sterilization and sterilizers in private practice, points which I could stamp with some degree of originality.—Journal Am. Med. Assoc.

The Preparation of Diphtheria Antitoxic Serum.

By H. K. MULFORD, PH. G.,

PHILADELPHIA, PA.

The discovery of diphtheria antitoxin was made by Behring as result of his primary and original investigation in connection with Kitasato upon tetanus antitoxin.

The method of preparation first proposed was the injection into suitable animals of cultures of the diphtheria bacilli in which the bacilli had been killed by heat. When the animal could withstand such injection, manifesting only a slight irritation or œdema at site of injection, or showing but feeble temperature reaction, highly attenuated living cultures were introduced in increasing amounts, a sufficient immunization or resistance being given by the primary injections to prevent fatal termination. The injection of living cultures, however, is greatly to be discouraged, since such injection and those of attenuated cultures containing dead bacilli are accompanied by great destruction of cellular tissue of the animal which is to furnish the antitoxin, its physical strength being lessened by such destructive processes.

The best method is as follows: As virulent a culture as possible of the *bacillus diphtheriæ* is obtained. It is grown upon Loeffler's solidified blood serum mixture and placed in an incubator at a temperature of 45 degrees C.

After a period of 24 hours the cultures are developed. From this a single culture or colony of the bacilli is transferred into small flasks of a 2 per cent peptone bouillon rendered decisively alkaline to litmus. These small flasks are placed in an incubator which is kept at a constant temperature of about 37 degrees C. for 24 to 48 hours, and afterward the contents are transferred with peptone bouillon into rounded flat flasks with a long neck (so that sterilized cotton may be pushed well into the tubulature) of a capacity of 500 ccm. These large flasks are placed

in the incubator and kept at a constant temperature of 37 degrees C. until the bacilli have become very numerous, and have secreted enormous amounts of active and powerful toxin in the bouillon.

When this has taken place a microscopical examination is made to see that bacilli other than the Klebs-Loeffler are not present, and the diphtheria toxin thus contaminated. If uncontaminated 1 per cent of trikresol is added to prevent contamination and to destroy the *bacillus diphtheriæ*. The bouillon, or, as we now term it, diphtheria toxin, is filtered through a modified Chamberland filter to separate from it the dead bodies of the diphtheria bacilli. No bacilli are therefore injected into the animals to be immunized, and they are not given diphtheria, but only the toxin secreted by the bacilli.

DETERMINING THE TOXICITY OF THE TOXIN.

The toxicity of the toxin is determined by its injection into guinea pigs. To be of the desired strength, 0.01 to 0.1 ccm. should produce death of the control animal in from 24 to 36 hours.

For the preparation of diphtheria antitoxin any animal may be selected, but horses are preferred, inasmuch as they are more easily operated upon, and because they furnish excellent serum in liberal amounts. Our experience as to the type of horses selected, particularly in the earlier observations, have been valuable, the majority being of unusually high quality, a number showing trace of fine breeding; such horses, however, are not suited for immunization. The finely bred horse being sensitive, frets at his inactivity (for no work is performed by the animal while being immunized, only a sufficient amount of exercise being given to maintain good health), neither does he take kindly to the injection of the toxin or the subsequent bleeding operations. The preference is given to large, compactly built animals, of dark color, 16 to 18

hands high, from 1,400 to 1,600 pounds weight, of quiet disposition, and possessing good health.

TESTING FOR GLANDERS AND TUBERCULOSIS.

Before the injecting with toxin, the malleine test for glanders and the tuberculin test for tuberculosis is applied, the results of such being clearly shown by the temperature. Animals responding to either of these tests must be discarded.

The primary injection of the toxin is 1 ccm. At equal periods of from six to eight days, constantly increasing amounts of the toxin are administered until in about ten weeks to three months as great quantities as 300 ccm. of this powerful toxin may be borne with tolerance.

When the injection of these larger amounts is accompanied with but little elevation of temperature, and but a slight oedema is manifested at site of injection, a trial bleeding is made, 20 ccm. of blood being taken from the jugular. If the tests for antitoxic value, as described later under the testing of antitoxin, are favorable, the horse is bled, the blood being collected in sterile bottles, and placed in a refrigerating room for a sufficient time (about 24 hours) until the fibrin coagulates, allowing the serum which contains the antitoxin to remain clear. This serum is drawn off by pipettes and preserved by the addition of 0.5 per cent trikresol.

The most important step now awaits the operator, the determination of the exact strength possessed by the antitoxin as expressed in immunizing units.

THE IMMUNIZING UNIT.

Immunizing units represent the strength of antitoxic serum that is required to save a guinea pig from ten times the absolute minimum fatal dose of the diphtheria toxin, and the strength of the antitoxin is designated by the number of immunizing units per ccm. of the serum.

For this purpose the minimum fatal dose of the toxin is

accurately determined by injections of various amounts of toxin into a number of guinea pigs, the smallest amount of toxin that invariably causes the death of the control animal in a reasonable time being regarded as the minimum fatal dose. It is usually calculated so much per 100 gm. body weight.

Every lot of antitoxin is carefully tested, and if the control animal shows evidences of œdema at site of injection, or diminution in body weight, the antitoxin is rejected.

A page from the laboratory minutes shows this determination of strength. Having found the minimum fatal dose here used to be 0.005 per gram weight of guinea pig, the control animals are given ten times this absolutely fatal dose of diphtheria toxin or poison, and if testing for 100 units per ccm., as appears from experiment on animal No. 1,080, 1-1000 ccm. antitoxin obtained from horse No. 109 H is given; if testing for 250 units per ccm., 1-2500 ccm. of antitoxin is given; if for 500 units, 1-5000 ccm. of antitoxin would be administered.

Tests for 500 units are shown on control animal 1,070 and for 350 units on control animal 1,076.

While this paper does not deal with the therapeutic value of diphtheria antitoxin, the absolute scientific value and correctness of these tests may be appreciated by these observations, and we prove the therapeutic application of the antitoxin by its neutralizing or protective value upon the control animals receiving ten times the amount of toxin that always kills. Unfortunately, we cannot thus arrive at the dose for therapeutic application since the human subject is much more susceptible to the poison, and we have no possible means of determining the amount of toxin secreted by the diphtheria bacilli in the patient suffering with diphtheria.

Appreciating, however, that the only effect of diphtheria antitoxin is in neutralizing the toxins of diphtheria, we know how necessary it is to make application of this

"healing serum" before the nerve centers become paralyzed, the heart and kidneys become diseased and the entire system invaded by the absorption of the fatal toxin.

THE PRESERVATION OF ANTITOXIN.

Diphtheria antitoxin is a most delicate substance, and its preparation can only be safely carried on in thoroughly equipped institutions where men of undoubted integrity of purpose and ability are in supervision.

While antitoxin is a delicate substance, yet, when a proper preservative in a sufficient amount is used, and it is hermetically sealed in sterile vials, it will preserve its strength and antitoxic value for at least six months; indeed, repeated experiments prove it retains its activity for a much longer period.

Chloroform, camphor, sodium salicylate, carbolic acid, and formaldehyde have been employed, but the preference is greatly in favor of trikresol and formaldehyde. Camphor seems to be particularly dangerous, since it possesses but a feeble preservative action, and its strong odor will prevent the detection of putrefactive processes should they be established; chloroform and sodium salicylate are unsuited on account of their active therapeutic effect.

Trikresol in a strength of but 0.5 per cent protects the serum absolutely; in fact, pathogenic bacteria do not develop with this percentage of trikresol; it is not a poison, as is carbolic acid, nor is it an irritant to the urethral tract. A disadvantage is that it produces a semi-fluorescent appearance in the serum, but the absence of cloudiness is shown by permitting the light to enter squarely through the vials containing the finished product.

STRENGTH OF SERUM.

Antitoxin is usually supplied in bottles containing varying quantities of serum, but of a certain number of antitoxic immunizing units. This is apt to lead to confusion,

and we would strongly recommend that a fixed standard of a definite number of immunizing units be secured in each ccm. of serum. While this involves extra labor, it prevents confusion on the part of the physician, and the end is well worthy of the increased labor. If serum is produced of a strength of 125 units per ccm., it may be mixed with an equal amount of serum containing 75 units per ccm.; the result is that each ccm. will contain 100 immunizing units, and if 500 units are desired to be administered, 5 ccm. will be understood as the requisite amount to be injected, etc.

HIGH POTENCY SERUM.

It is a matter of gratifying interest to Americans that serums of the highest antitoxic values have been prepared in our country. Serums are now produced of which each ccm. contains as much as 800 units, and we confidently believe that as much as 1,000 antitoxic units to the ccm. will be produced in the near future. This overcomes the chief objection that has been urged against the serum even by its warmest advocates. More prompt absorption will take place, insuring quicker results, besides the attendant dread caused by the large instruments necessary for the introduction of larger amounts of weaker serum will be avoided, as much as 2,000 units being administered in an ordinary two ccm. or 30 minim syringe.

DRIED SERUMS.

Dried serums are much less active than fluid or fresh ones. They are prepared by addition of aluminum or ammonium sulphate, with subsequent precipitation of the antitoxin by a 1 per cent soda solution or by inspissation. They have given fairly good results, but cause greater irritation than do the fluid serums, and not being freely soluble, cause annoyance in administration and give greater opportunities for contamination in their preparation and dilution for administration.

HOW ANTITOXIN ACTS.

We do not know what action takes place in the serum of the horse producing the antitoxin, nor do we know positively its action upon the organism of the control animal or the patient treated for diphtheria. The fact that the control animals always recover under the influence of antitoxin, while they always die with but one tenth the amount of toxin, and the reduction in mortality of patients ill with diphtheria under the influence of antitoxin, are, however, self-convincing. No reason can exist for its non-employment on this ground, since we do not know the nature of the changes from pepsin to pepsines, albumen to albuminoids; the action of arsenic in anæmia, mercury in syphilis, and many of our therapeutic agents. They are used empirically because favorable results are secured.

The accepted theory of the action of antitoxin is that it renders the living cells of the organism tolerant to the toxin liberated by the diphtheria bacilli and by increasing this tolerance they are able to overcome these toxins.

That antitoxin exerts no chemical action on the toxin can be proved by mixing toxins and antitoxins, and maintaining the mixture at a temperature of 70 degrees C. for some time. At this temperature the antitoxin is destroyed, while the toxin remains but slightly disturbed in virulence.

Ewing and Billings have made numerous experiments as to the action of antitoxic serum upon the blood, and agree that: "In cases of diphtheria treated with antitoxin the diminution in the number of the red corpuscles is much less marked than in those cases treated without it. The leucocytes are apparently unaffected in number by the antitoxin, the hæmoglobin is also much less affected in the cases treated with antitoxin, thus confirming the statement as to the red corpuscles, while the leucocytes are stimulated in action, as evinced by taking more vivid color when stained with indigo solution."—*Am. Druggist*.

EDITORIAL.

The Cochineal Insect.—The cochineal insect is a native of Mexico, where it was raised by the Mexican Indians long before the country was discovered by the Spaniards. It is now cultivated in the West India Islands and in some of the Southern States but only in Mexico does it form an article of commerce.

The insect is raised on the cochineal tree, or nopal, which is a species of cactus. It grows freely from cuttings, and these are fit to receive insects after eighteen months. Into a nest formed of a thread-like substance or of cottony matter, a few females are placed about the first of October. The nests are fastened to the side of the tree facing the rising sun, and eggs are soon laid. As each female produces upwards of a thousand eggs, a large colony is formed. Six generations are produced in a single year.

On first leaving the egg the insects are quite lively and run about over the tree. They are so small as to require a magnifying glass to see them. They are flat, ovular, without wings and with short antennæ or horns. The females have a small, short, almost conical beak, placed between the first and second pair of feet, which contains a sucker. It is by means of this sucker that they draw forth the juices of leaves and tender stems.

When the insect has reached the perfect state, it is filled with a multitude of minute eggs. These she lays, then dies, her body becoming a covering for the eggs until they are hatched. When this is done the insects work their way out and commence feeding. After a short time their skins harden and serve as a cocoon. From this they pass into a chrysalis state, and soon after appear as the perfect insect.

The cochineal is collected about the first of December. The insects are removed from the trees with a knife or squirrel tail. They are then dried by heat or in the sun. When the cochineal arrives in the market it is in the form

of a small grain, concave on one side and convex on the other, having a little resemblance to the body of an insect. It colors purple naturally but when mixed with nitromuriatic acid gives a beautiful scarlet.

New deposits of Infusorial Earth found in Europe.—Some large deposits of kieselguhr (infusorial earth) have been discovered at Kissatib, near Achalzich, in the Caucasus. It occurs in strata which altogether are about 40ft. in thickness. Some of the strata are of a snowy white, while others are beautifully striped in various ways by layers of oxide of iron, etc., thus resembling marble. Efforts are being made to find a process for hardening this material, for its variety of beautiful designs combined with extreme lightness would make it a precious stone for architectural purposes. White kieselguhr is used for a variety of purposes, as in the manufacture of dynamite, colours (ultramarine), matches, for isolating purposes, etc. The Kissatib, kieselguhr is remarkable for its purify (3 percent of sand) and whiteness.

MICROSCOPICAL APPARATUS.

The Microscope in Pharmacy.—The pharmacist of to-day finds considerable use for the microscope; the pharmacist of to-morrow will find it an indispensable accessory in his business. Already a limited knowledge of the use of the instrument is required in the examination room, and as time passes the requirements in this direction are likely to be greatly extended. Accordingly, it seems desirable to point out that the microscopical examination of substances is simply an essential step in the complete visual examination of those substances. Everyone realises that the nearer, within certain limits, an object is brought to the normal eye, the larger it appears and the more distinctly its details are apparent. When brought within a distance of two or three inches, however, the image becomes blurred and indistinct, whilst an object held close to the eye cannot be seen at all, and simply obstructs light.

Now the use of a hand lens enables one to bring an object under examination much closer to the eye than is normally possible, for the outer surface of the lens represents that of the eye for the time being. As a result the object appears much larger, and more structural detail is revealed than when the object is viewed by the unassisted eye. Similarly, the compound microscope still further lessens the distance between the object and the eye, the surface of which is now represented by the front of the objective, and to speak of the image of an object as being enormously magnified under the microscope is simply another way of expressing the fact that the object has virtually been brought into such close proximity to the organ of sight as is normally impossible. Examination of an object by the aid of the microscope, therefore, must be regarded as a mere extension of the limits within which the normal human eye is capable of clearly distinguishing the details of objects. As spectacles help the partially blind to see, so the microscope enables those with perfect eyes to see more than is possible without such aid, and the natural conclusion is that pharmacists and others whose skill is partly dependent upon the accurate impressions they form of the appearance of objects, should be adepts in the use of an instrument that can so increase their natural powers.—Pharmaceutical Journal.

MICROSCOPICAL MANIPULATION.

Preservation of Microscopic Specimens.—Dr. Jores describes a method, which he has tested for a year and a half of preserving organs and tissues so that they retain the color they had when fresh. He finds that five to ten parts of a fifty per cent solution of formalin alone causes the organs to assume a tint which varies considerably from the natural color. But instead of using water to dilute the common formalin solution, he uses one part common salt, two parts of Magnesium sulphate, two parts sodium sulphate in one hundred parts of water. This preserves the color of the blood.

Further, material preserved in such a solution is better adapted for subsequent microscopic examination, since the protoplasm of the cell is less altered and the nucleus stained better and deeply.

The method he adopts is as follows:—The material must not be too long washed in water, and should be left in the formalin for a period depending on size and thickness. A kidney or spleen requires two days' immersion and the solution should be changed until it no longer gives a dirty brownish red color. Care must be taken to bring all portions of the object into contact with the solution, and the object must be given the color it is to retain permanently, since the formalin solution causes it to assume a consistency such that its shape cannot afterwards be modified. In the formalin solution the organs change color and become of a dirty bluish grey. On placing them in ninety-five per cent alcohol the normal color returns. Before permanently placing the organ in alcohol it must be washed in alcohol until the latter no longer becomes cloudy. The material must not be washed with water; it is left in alcohol until the normal color returns; if left longer the alcohol removes the color. For a kidney or spleen, twenty-four hours will be sufficient. The permanent preserving fluid is equal parts glycerine and water; the material floats at first but sinks later; the color is now at its best, after a little while the fluid becomes yellowish and wants renewal. Tissues so preserved have not undergone the slightest alteration in nine months.

The method is not applicable to other color than blood.—*Int. Med. Magazine.*

Infiltrating Dental and Osseous Tissues for Microscopical Work.—At a recent meeting of the Odontological Society of Great Britain Mr. Charters White gave the details of the method he adopts to demonstrate the presence of spaces in hard sections of dental and osseous tissues. The section to be treated must be ground moderately thin, to about 1-32 in., and then immersed in absolute alcohol for five minutes, and subsequently in ether for a similar period. It is next transferred to a thin solution of celloidin

(three grains of celloidin to half an ounce of equal parts of absolute alcohol and ether). This solution is colored red by the addition of fuchsine, the stain being added to the alcohol before the celloidin is dissolved. The specimen is allowed to remain in the solution for two or three days, after which it is removed and placed on paper to dry. The section is then ground to the desired tenuity and mounted on balsam. The advantages of the process are (1) the cavernous and tubular structures in dentine and bone are filled with a colored medium, which prevents the balsam from running into such spaces and so obliterating them; and (2) the section is rendered less brittle and can, therefore, be easily ground down without much fear of fracture.—English Mechanic.

BIOLOGICAL NOTES.

An international botanical garden is to be established at Palermo, under the direction of Prof. Borzi, of the University. It is hoped that the favorable position of the garden may attract foreign students.

It seems certain now that the late Dr. Alfred Nobel has made a munificent bequest to science. According to the terms of his will, so it is said, a fund is to be formed from all his realisable property, the yearly interest from which is to be divided into five equal portions, the first of which is to be allotted as a prize for the most important discovery in the domain of physics; the second for the principal chemical discovery or improvement; the third for the chief discovery in physiology or medicine; the fourth for the most distinguished literary contribution in the same field; and the fifth is to be allotted to whomsoever may have achieved the most or done the best to promote the cause of peace. All these prizes are open to the world. After deducting a few bequests to individuals, it is expected that the fund thus devised to the cause of progress will amount to the sum of nearly two millions sterling.—English Mechanic.

Mr. George J. Burch, of Oxford, England, has been experimenting upon plants with Röntgen photography. He finds that flower buds and seed vessels are especially favorable objects. He believes that if the photograph could be made upon a magnified scale the outline of every cell would be seen. The capsules of hyacinth and the flower buds of fuschia are reproduced in his account published in *Gardeners' Chronicle* III.

Numbers 11 and 12 of Lloyd's Photogravures of American Fungi have recently been distributed. They represent respectively *Lepiota morgani* Peck and *Sparassis herbstii* Peck, two interesting species. The first was photographed as it grew in the field, and makes an unusually attractive and characteristic picture.

BACTERIOLOGY.

Bacteriosis of Carnations.—Dr. J. C. Arthur and Prof. H. L. Bolley give an excellent account of one of the most serious difficulties the carnation grower has to encounter, namely, Bacteriosis which they ascribe to a new organism, *Bacterium dianthi*. The organism responsible for this disease is oval or elliptical in outline and does not occur in chains. It is motile and produces zoogloea. In gelatin it produces at first a smooth even growth along the track of the needle, having a pale cream color, later it assumes a marked appearance and the color is bright orange, being much deeper in acid cultures. It slowly liquefies gelatin. The zoogloea are formed as follows: "Certain individuals, without ceasing active multiplication, become non-motile, and at once begin to excrete a gelatinous envelope. This envelope offers considerable resistance to longitudinal extension, and the new cells as they form slip past one another, accumulating in an elongated mass, which increases faster in thickness than in length." If the nutrient material is not renewed, the zoogloea disintegrate in ten to fifteen days by liquefaction of the gelatinous envelope; this permits the bacteria to fall to the bottom of the fluid. They multiply very rapidly, a well marked constriction occurred

within seven minutes and in twenty minutes more there were two full grown bacteria formed from each original cell, although still attached to each other. At this rate of multiplication 280,000,000,000 would be formed in twenty four hours. They would occupy fully one inch of cubic space. This organism is an aerobe and makes comparatively rapid growth at 8-10 degrees C. The rate of division increases up to 34-36 degrees C, but above this point it is less rapid. Some growth was obtained at 45 degrees C. As to its parasitic nature, in its early stages the individual bacteria are imbedded in protoplasm, the chlorophyll grains become disorganized, the protoplasmic utricle is broken up and the contents of cell are disintegrated. This germ has the power of eroding the cell-wall and thus dissolves for itself a passage way, which may be brought about by an enzym and it is probable that the perforation in the cell-wall is quickly healed by growth and swelling of the same. They enter the host by means of stomata or accidental punctures. It readily attacks young and partly grown leaves. In addition to an account of the distribution of the disease and the varieties affected they treat the economic aspect. The paper is accompanied by two excellent colored plates and six other plates which show the character of the organisms. (Purdue University, Agrl. Exp. Sta. Bull., No. 59, Vol. VII, March, 1896.)

Microbes that Make Glucose.—Everyone knows the service-berry, that decorative shrub that retains its bright red berries even in the middle of winter. Now these berries were the subject of a sort of puzzle about half a century ago. In 1852 Pelouze, examining the juice of service berries that had been left for a long time at the bottom of a dish, discovered a perfectly crystallised substance, very sugary, and having all the properties of glucose. He saw nothing here that was not perfectly natural. We find sugar everywhere, or almost everywhere; there was therefore nothing astonishing in the discovery, and the new sugar was christened *sorbine* or *sorbose*. But now began the puzzle. When, a little later, other scientists de-

sired to prepare some sorbose directly, they could not get any. Byschl and Delffs could obtain it neither from the fresh nor the fermented juice. In short, the fantastic sorbose, born by chance in a laboratory retort, refused absolutely to make its appearance again. We know now why this was; the mystery has been brought to light by a chemist at the Museum—M. Bertrand. By crushing ripe service-berries and then exposing them to the open air M. Bertrand obtained first alcohol by ordinary fermentation, and soon a whitish layer covered the surface of the liquid; the alcohol disappeared in its turn, the layer grew mouldy, but in the remaining liquid it was proved that there was no trace of sorbose. He tried again and again, and one fine day on the layer of which we have spoken a fly alighted, a little red vinegar fly. Then all was changed. The membrane thickened, soon swarmed with larvæ, and in the liquid below it great quantities of sorbose appeared. This is what had taken place: the membrane was made thick and heavy by the thousands of microbes that had been brought by the little red fly, microbes whose oxidising influence had rapidly transformed the juice of the service-berries into sorbose. The experiment, after that, could be repeated at will. Thus recognised at length, the industrious microbes, whose length is less than a thousandth of a milli-metre (.025 of an inch) require no urging to manufacture in a few hours nearly a kilogram (2lb.) of the new kind of glucose.—Cosmos.

The experiments made with nitrogen in this country do not seem to be conclusive (see p. 561, Aug. 7 last). An important paper on the subject has appeared in a German bacteriological journal, giving experiments showing the capability possessed by *Bacillus radiciola* of growing on foreign culture media. It will be remembered that Dr. Nobbe isolated some twenty of these nitrogen-assimilating bacteria from the root nodules of various leguminous plants, and has endowed them with the collective title of "Nitragin." In the present experiments bacteria from the lucerne nodules were cultivated in pure media derived res-

pectively from infusions of lucerne and from white mustard, their cultivation being carried on through several generations. On the lucerne gelatine the bacteria flourished abundantly up to the last; on the mustard gelatine they gradually faded away. It was tried if these lucerne-nodule-bacteria could be induced to thrive on the mustard medium by gradual training, and in the course of six months that was accomplished.—English Mechanic.

MEDICAL MICROSCOPY.

Test for Typhoid Fever.—William Trelease, Recording Secretary of the Academy sent to *Science* the following account of the meeting January 4, 1897: Dr. Amand Ravold gave a microscopic demonstration of Widal's test for typhoid fever, demonstrating that after the disease has existed for four days or more the blood of typhoid patients, probably because of some contained anti-toxine, possesses the power of inhibiting the motion of typhoid bacilli from a pure culture introduced into it within a period of one hour or less, whereas in normal blood similar bacilli retain their power of locomotion for an indefinite length of time. It was stated that typhoid blood possesses this property even after having been dried for a period of four weeks or more, so that a few drops obtained from a person suspected of having the disease may be sent to suitable places for applying the test, thus rendering comparatively easy the early diagnosis of a disease which in its early stages presents many clinical difficulties.

PERSONALS.

We learn through the newspapers that on December 26, the remains of Prof. Louis Pasteur, the eminent bacteriologist, who died September 28, 1895, were removed from the Cathedral of Norte-Dame to the Institute, where they were received by a gathering of distinguished men, including Premier Meline, MM. Rambaud and Brisson and sev-

eral well known men from Great Britian. President Faure and Gen. Billot, the minister of war, were represented at the ceremony. Speeches were made at the crypt of the institute by M. Rambaud, M. Bodin, president of the municipal council of Paris, Dr. Evans, Dr. Rice Duckworth and others.

Dr. John B. Hamilton has resigned from the Marine Hospital service.

Dr. Geo. H. Rohe, Secretary of the Rush Monument Committee reports October 31, that since the last report in April he has received the small sum of \$159.00 making a total of \$3,886.39.

Dr. Hugo de Vries has been appointed director of the botanical gardens at Amsterdam in the place of Dr. Oudemans.

Dr. J. de Winter, assistant in the Zoological garden at Antwerp, has been made director of the Zoological garden at Giseh, near Cairo.

It is announced that Pfeiffer has found an efficacious and reliable antitoxin for typhoid fever.

Dr. W. M. L. Coplin, of Philadelphia, has been appointed bacteriologist to the Pennsylvania State Board of Health, and Dr. Richard Slee of Swiftwater, Dr. Nelson F. Davis, of Bucknell University, and Dr. Robert L. Pitfield, of Germantown, assistant bacteriologists.

The widow of Baron Maurice Hirsch, of Vienna, has resolved to present two millions of francs (£80,000) to the Pasteur Institute, as a memorial of her husband.—English Mechanic.

MICROSCOPICAL NOTES.

Mrs. J. E. Reeves, 201 McCallie Ave., Chattanooga, Tenn., has 35 or 40 dozens of "unnamed" slides to sell. They are the last work of her late husband, Dr. J. E. Reeves. She has also as many or more of "named" slides.

A good microscope for sale cheap. Pacific Medical Journal Office, 603 Sutter St., San Francisco, Cal.

Barbados.—The official papers of Barbados spell the word as above and not as we have heretofore given it in the articles of certain contributors—Barbadoes.

A small crystal of Thymol will preserve urinary sediments.

There is now once more a University of Paris. The inauguration has been celebrated in the new building of the Sorbonne.

The twelfth International Congress of Medicine will take place from August 19th to 26th, 1897, at Moscow.

It is reported that a lady has presented the French Academy with 800,000 francs, the interest of which is to go to any one who will discover a cure for consumption.

The annual budget in Paris for the Assistance Publique amounts to the large sum of \$8,000,000; of this the medical and surgical personnel receives \$200,000.

A report comes from the Medico-Surgical Society of Antwerp of the discovery of an antitoxin for pneumonia by Dr. Mennes, of Louvain. The microbe is stated to be extremely small, of a shape approaching an oval. At present successful experiments have been confined to animals.—English Mechanic.

Ink for Writing on Glass.—Shellac 20 parts, alcohol 150 parts, borax 35 parts, water 250 parts. Water soluble dye, sufficient to color. Dissolve the shellac in the alcohol, the borax in the water and pour the shellac solution slowly into that of the borax. Then add the coloring matter, previously dissolved in a little water.

Dr. Sidney Yankauer of New York County, exhibited at the thirteenth annual meeting of the New York State Medical Association, 1896, a simple and inexpensive microtome which he devised. With the model shown he said he had cut sections in celloidin a thousandth of an inch thick, and in paraffin sections only one five-thousandth of an inch thick

THE MICROSCOPICAL JOURNAL.

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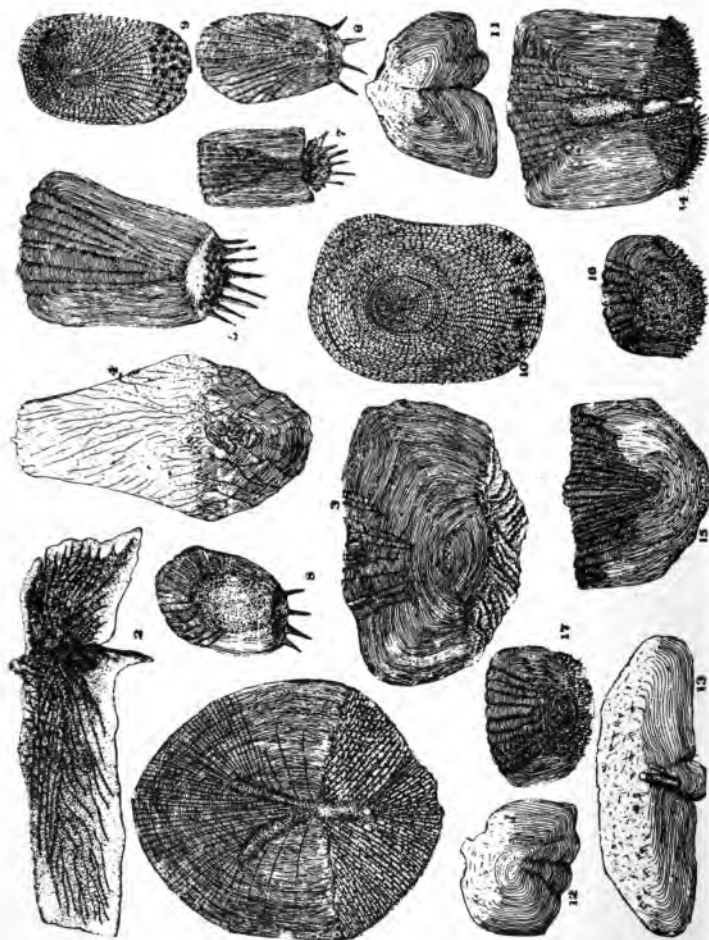
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10. Tom-cod.
11. Minnow.
12. Minnow.
13. Minnow.
13. Minnow.
14. Perch.
15. Cod (lateral).
16. Cod (?).
17. Opal.

1. German Carp, (lateral).
2. Stickleback.
3. Bluefish.
4. Herring.
5. Sole.
6. English Sole.
7. English Sole.
8. English Sole.
9. Tom-cod.

SCALES OF FISHES.

THE AMERICAN
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MAY, 1897.

No. 5

Notes on Some New, or Presumably New, Infusoria.

BY J. C. SMITH,

NEW ORLEANS, LA.

(Continued from Page 117 of last Month's Journal.)

Family.—Anisonemidæ. S. K.

Genus.—Entosiphon. Stien.

Species.—Entosiphon emarginata. (fig. 12.)

Body subobovate; less than twice as long as wide; anterior extremity slightly emarginate and flexed towards the ventrum; posterior extremity obtusely pointed; the right hand half of the anterior border slightly concave; dorsum convex and smooth; ventrum plane; oval aperture at apex of anterior emargination; pharyngeal tube extending in a median line from the oval aperture through two thirds of the body length; flagella originating together and to the right of the oval aperture; the anterior one equal to one body length and the posterior one to two body lengths; contractile vesicle conspicuous and located in the anterior half just below the dextral concavity; nucleus round and subcentral; endoplasm bluish and granular in posterior body half; locomotion as *Entosiphon sulcatus*. Duj. Size 1-1833 inch. Habitat—Pond water with algæ. Longitudinal fission.

This minute specimen of the genus resembles very much in outline the *Anisonema pusilla* of Dr. Stokes, but the resemblance goes no further. The pharyngeal tube is protusile and this is made very apparent when the

infusorian is pressing up against debris, in the act of feeding. The movement of the body during natation is the same smooth even glide of the genus. This form has been found quite abundant at times and but once has reproduction been observed—the process occupying about one hour.

Family.—Enchelyidæ. S. K.

Genus.—Enchelys. Ehr.

Species.—Enchelys audobonii. (fig. 13.)

Body obovate, the anterior border produced in a snout-like manner, subcylindrical, soft and changeable in shape more than twice as long as wide; entirely and sparingly ciliate; oral aperture apical, cleft-like and continued medially for about one-sixth of the body length, as a conspicuous, non-plicate, wedge-shaped membranous pharynx; oral cilia much longer, heavier and more numerous than the body cilia; a single hair-like seta extending from the posterior border as long as one-half the body length; contractile vesicle round, conspicuous and located in posterior third, nucleus round and subcentral; endoplasm granular and of a greenish tint, usually containing food balls. Reproduction by transverse fission; conjugation by the application of the oral apertures. Locomotion rapid and by revolution on long axis. Size 1-600 to 1-460 inch. Habitat—Pond water with decayed leaves from Audobon Park, New Orleans, La.

This infusorian was found in great abundance a number of times in pond water taken from Audobon Park. While the most persistent shape is obovate it is, like *Enchelys farcimen* Ehr., subject to many changes of form from an ovate to almost globular. The oral aperture forms the base of the wedge-shape pharynx and is persistently open. It is a greedy scavenger. The writer has a number of times observed a dozen or more surrounding some dead form ravenously devouring it. The elas-

ticity and capaciousness of the oral aperture and pharynx has been often demonstrated by the engulphing of particles of food twice the size of the infusorian. The caudal seta is difficult to see excepting when the infusorian is quiet.

Family.—Prorodontidæ. S. K.

Genus.—Holophrya. Ehr.

Species.—Holophrya pogonias. (fig. 14.)

Body ovate, subcylindrical, exceedingly elastic and changeable in shape; twice as long as wide; posterior evenly rounded, anterior transversely truncate and including oval aperture; body entirely and finely ciliate; coarsely striated longitudinally; oral and body cilia not diverse; a supplementary fascicle of extra-oral cilia situated just below the oral aperture; these cilia much heavier (not setose) and about three times longer than the body cilia; projecting upwards and some distance above the oral aperture; contractile vesicle round, conspicuous and centrally located; nucleus botuliform and placed longitudinally alongside the contractile vesicle; endoplasm granular, of a yellowish tint and usually containing large food balls; locomotion in a wabbling manner by revolution on long axis. Size 1-150 μ inch. Habitat—Brackish water from Lake Pontchartrain.

The writer has some doubts as to the position of this form and has placed it among the Prorodontidæ provisionally. In its habits and general appearance it resembles the Holophrya, but the presence of the extra-oral cilia may prevent its being placed among this family.

Family.—Colpidæ. Ehr.

Genus.—Coleps. Stien.

Species.—Coleps striata. (fig. 15.)

Body subovate, cylindrical, slightly elastic but persistent in shape; less than twice as long as wide; anterior

transversely truncate and including oral aperture; posterior evenly rounded; heavily striate longitudinally; the spaces intervening finely and closely striate transversely oral cilia longer than body cilia, but not setose; contractile vesicle large and postero-terminal; nucleus roundish and sub-central; oval aperture to one side and just above the contractile vesicle; endoplasm granular; locomotion even and by revolution on long axis. Size 1-500 inch. Habitat—Fountain water with aquatic plants.

This form would, if it possessed the setose oral cilia, certainly be classed as a *Plagiapogon*-Ehrenberg. The very heavy longitudinal striation, which are almost band like in this new form, and the fine transverse striation of the intervening spaces are also characteristic of the genus *Plagiapogon*. In its habits it is the same scavenger that the *Coleps hirtus* is.

Family.—Lembidæ. S. K.

Genus.—*Lembus*. Colin.

Species.—*Lembus attenuata*. (fig. 16.)

Body elongate, subcylindrical; elastic but persistent in shape: about six times as long as widest part; widest at the center and tapering to both extremities; anterior transversely truncate; posterior ending in a sharp point, an undulating membrane and a furrow commencing just behind the anterior border and extending backward to the oral aperture, which is situated at the junction of the first and second body fourths; body sparingly clothed with cilia and these cilia as long as the widest central part of the body; oral cilia same size as body cilia but more numerous; undulating membrane capacious and extending as far out as distal ends of oral cilia; contractile vesicle conspicuous and situated centrally near the ventrum; endoplasm bluish and semi-opaque, locomotion vermicular.

Size 1-325 inch. Habitat—Stale pond water.

So far as the writer knows this is the first fresh-water member of the family recorded.

Family.—Dysteriidae. S. K.

Genus.—Trochilia, Dujardin.

Species.—Trochilia fluviatilis. (fig. 17.)

Body subelliptical; almost twice as long as wide; carapace single, dorsum broadly convex; anterior obliquely truncate to ventrum, posterior rounded; ventrum plane and clothed with fine short cilia; a movable stylet appendage originating in the posterior third of the ventrum and projecting to a short distance beyond the posterior border; projecting from, and within the anterior truncation, are numerous fine vibratile cilia; this truncation also includes the oral aperture and proceeding backward from this aperture is a tubular pharynx which continues directly upwards, through three fourths of the body length; this pharynx is protusile; contractile vesicles, three, two located in the anterior body half, above the pharynx and near the dorsum and one in the posterior body half below the pharynx and near the ventrum; nucleus not observed,—obscure; endoplasma, bluish and very often vacuolar, size 1-850 μ . Habitat, Pond water with aquatic plants, ponds connected with the Mississippi river.

For one month the writer got a number of dips from a pond in Audobon Park, New Orleans, and in almost every one of the numerous examinations made of this water, were found an abundance of this form. They move about and through debris piles very much as an Aspidisca. In no single instance, when they were examined closely and measured, was there the slightest difference in shape or size. While the truncated anterior was pressed against a heap the tubular pharynx could be seen distinctly to move forwards, as is observed in the case of Entosiphon sulcatus, Duj. Unfortunately the

nucleus could not be observed even after the most careful search and the application of the usual reagents. In some samples examined all the forms under the cover glass were densely vacuolated.

Family.—Onytrichidæ. S. K.

Genus.—Stichotricha. Perty.

Species.—Stichotricha opisthotonoides. (fig. 18.)

Body elongate; somewhat club shaped, the anterior two thirds attenuate, three times as long as the widest part; highly elastic but persistent in shape; addicted to curving backwards; peristome channel-like and extending from the apex to the posterior body third and there curved towards the left hand body border, the peristome cilia long and heavy diminishing in size as they approach the oral aperture; the left hand border of the peristome finely ciliated and bearing a conspicuous undulating membrane, marginal setæ on the anterior half of the sinistral border and on the posterior border; two oblique rows of small ventral setæ extending from the sinistral to posterior setæ; contractile vesicle conspicuous, located in the posterior third and in contact with the left hand border which it extends at each expansion; nucleus, two, ovate and situated one in each body half; locomotion eccentric. Size 1-450 μ ch.

Habitat—Old infusion of aquatic plants in ditch water.

The writer had under observation quite a large number of this new form and they were all addicted to the habit of bending the anterior attenuate body half backwards as if in great pain; it was this peculiar habit that suggested its specific name. While in this act the undulating membrane is thrown out from the body border to a considerable distance. The writer has never seen recorded that any of this genus possessed an undulating membrane and believes this species stands alone in this

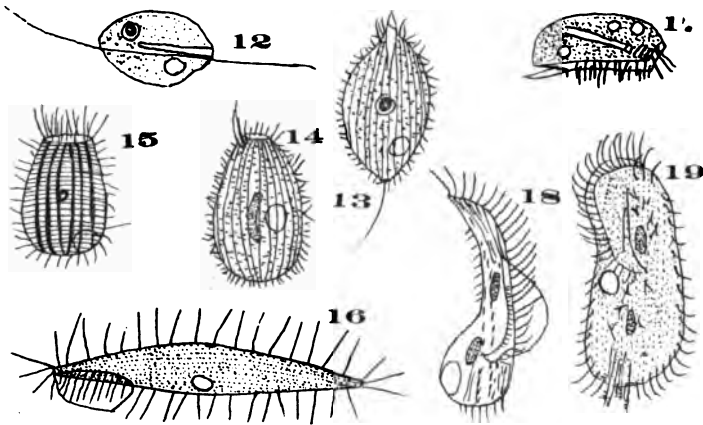
respect. The *Stichotricha secunda*—Perty, and *Stichotricha aculeata*—Wrz, are often seen in the pond waters in New Orleans and bear only a superficial resemblance to this form.

Family.—Oxytrichidæ. S. K.

Genus.—Oxytricha. Ehr.

Species.—Oxytricha furcatus. (fig. 19.)

Body elliptical, both extremities evenly rounded; very



12.—*Entosiphon emarginata*. x 1300.

13.—*Enchelys audobonii*. x 500.

14.—*Holophrya pogonias*. x 150.

15.—*Coleps striata*. x 375.

16.—*Lembus attenuata*. x 730.

17.—*Trochilia fluviatilis*. x 740.

18.—*Stichotricha opisthotonoides*. x 675.

19.—*Oxytricha furcatus*. x 225.

soft and flexible, less than two and a half times as long as wide; the left hand border slightly concave anteriorly lip crescentic and conspicuous; peristome extending to centre of body and strongly curved to oral aperture; the right hand border of peristome bearing an undulating membrane; frontal styles, eight and arranged as on *Stytonychia mytilus*, Ehr.; the three most anterior uncinat, and the remaining five furcated; ventral series arranged as on *Stytonychia mytilus*, Ehr., and all furcated; anal

styles, five, fimbriated at their distal ends and all, but the one nearest the left hand body border; projecting beyond the posterior marginal setæ continuous, heavier and longer posteriorly; contractile vesicle located at the centre of the left hand body border; nucleus, two, elongate, one in each body half. Size from 1-200 to 1-150 inch. Habitat—Old infusion of rose fission petals. Transverse.

This form was found exceedingly abundant in an old infusion of rose petals, feeding ravenously on the very abundant bacteria. Many of them seemed so gorged with food that they moved about very lazily, affording the writer a good opportunity for their observation. The fine inferior frontal styles and all of the ventral series were invariably furcated to within almost their origin; bifurcated usually, a few specimens distinctly tri-furcated. In a few specimens the three superior of the frontal series were bifurcated and in some rare instances an odd one or two of the marginal series were bifurcated. The distal ends of all of the anal series, for about one fifth of their length, were distinctly and uniformly fimbriated.

SUPPLEMENTARY NOTE UPON ACTINOMONAS PRIMUS.

An infusorian somewhat similar to this form is described by Dr. Gruber under the title of *Dimorpha mutans*.^{*} In its flagellate condition, the *D. mutans* resembles a *Heteromita*, having an anterior vibratile and a posterior trailing flagella. In its Heliozoan state the pseudopodal rays equal from two to three diameters of the zooid and decussate.

ERRATA: Wherever the word "Ventrum" appears read "Ventral Surface."

In family Anisomidæ, Species *Diplomastix rostrum*, read "rostratus" for rostrum.

In family Anisomidæ, Specie *Entosiphon emarginata*, reverse the figure, making the right hand border the left hand. Contractile Vesicle following the change; the figure should be turned over. In the diagonosis of this Species where the word right or dextral appears read "left" or "Sinistral."

^{*}Appendix to vol. II Kent's Manual of the Infusoria.

Preparation of Culture Media with Special Reference to Sterilization.

BY RAYMOND C. REED, Ph. B.

[Assistant in the Department of Comparative Pathology and Bacteriology, New York State Veterinary College, Cornell University, Ithaca, N. Y.]

The amount of culture media used by the students in a bacteriological laboratory is so great that its preparation after the method given in the text books occupies an undue proportion of the time allotted to this subject. If it is prepared by an assistant and furnished to the students it not only takes much of his time, but it deprives the student of the opportunity of learning one of the most important processes necessary for successful work in bacteriology. Hence any change which will shorten the time required for its preparation will be of value. When it is prepared by the usual method recommended in text books on Bacteriology at least three days are necessary to complete the process of sterilization. The method of sterilizing by which the media is heated to a somewhat higher temperature than 100° C. by means of superheated steam is open to the objection that the nutritive properties are impaired to a greater or less extent for certain species of bacteria.

In 1890 Moore* published a paper giving the method employed in the Bureau of Animal Industry for making nutritive agar and which seems to be the one recommended, with slight variations as to details, in the greater number of bacteriologies. The two most important changes suggested were, (1) that when the agar was made from meat infusion instead of meat extract, it should be prepared from bouillon which could be made up in quantities and kept stored in flasks as stock ready for use. This applies not only to the making of agar but also gelatin

*The Preparation of Nutritive Agar. By V. A. Moore, M. D., American Microscopical Journal, May, 1890.

or any other medium which requires a meat infusion for its nutritive base. (2) That the agar should be cut up in small pieces and dissolved in a liquid which contains no coagulable material before it is added to the bouillon. This is done by using the proportion of five grams of agar, finely chopped, to 100 c. c. of water and boiling in an agate iron dish over a direct flame with constant stirring. I have found, however, that it is more satisfactory to boil the agar in a closed water bath. This takes not to exceed twenty minutes longer and as there is no danger of the agar burning the stirring and constant attention required when it is dissolved over a flame is unnecessary. By this method the agar is completely dissolved and a medium of a known consistency can always be made.

In 1892 Schultz,* of the Johns Hopkins Hospital, described a rapid method of making agar which requires but one hour for the whole process. For this he uses meat extract which gives a medium favorable for the growth of some organisms but not for others. He also gives a method by which the agar may be made from meat infusion taking but an hour and a half.

The following method of preparing media has proved very satisfactory and in my hands more so than the one described by Schultz although his process has many advantages.

The preparation of peptonized bouillon.—To 1000 grams of finely chopped or ground meat (beef or veal) add 2000 c. c. of distilled water. Put in an agate iron dish and heat in a water bath at a temperature of from 60° to 65° C for two hours or allow it to macerate in a cool place for 24 hours. Strain through a coarse cloth and bring the amount of liquid up to 2000 c. c. by adding water if necessary. To this infusion add $\frac{1}{2}$ per cent peptone and

*A Rapid Method of Making Agar-agar. By John L. Schultz. John's Hopkins Hospital Bulletin, No. 24, July—Aug., 1892.

$\frac{1}{2}$ per cent sodium chloride and if a neutral or alkaline medium is desired add enough of a 1 per cent solution of caustic soda to bring about the required reaction. Boil in a water bath for half an hour. Cool and filter through ordinary filter paper and distribute in sterilized flasks. The amount in each flask is to be determined by the work in the laboratory. I have found 500 c. c. a convenient quantity.

Preparation of nutrient agar.—Dissolve 5 grams of finely cut agar in about 100 c. c. of water. This may be done in either of two ways, by heating over a direct flame for about ten minutes with constant stirring to prevent burning or by heating in a closed water bath until the whole mass becomes gelatinous. The agar is then added to 500 c. c. of bouillon, thoroughly mixed with it and boiled in a water bath for twenty minutes. It is then cooled down to 45° to 50° C. and the whites of two eggs added and thoroughly mixed with the agar. It is then returned to the water bath and boiled for from twenty to thirty minutes. The albumen will then be collected in a firm coagulum containing any insoluble particles that may have been in the agar, leaving a perfectly clear liquid. It is filtered while hot through ordinary filter paper, the filtration taking place rapidly without the aid of a hot filtering apparatus. The filtrate is then distributed in tubes which have been previously plugged with absorbent cotton and sterilized.

Preparation of nutrient gelatin.—To 500 c. c. of bouillon add 50 grams of gelatin and heat in a water bath until the gelatin is dissolved. Cool to about 45° C. and add the whites of two eggs, mix thoroughly. This is done most rapidly and effectually by pouring the liquid several times from one dish to another. Then boil in a water bath for twenty minutes. Filter through ordinary filter paper and distribute in sterilized tubes. Care

must be taken not to boil gelatin too long or it will lose its property of solidifying when cold.

Sterilization of Media. It will be seen that the process of preparing culture media up to the point of sterilization is practically the same as that described in recent text books on bacteriology. The method is short and by having the nutritive medium prepared and kept in stock the preparation up to this point of either agar or gelatin is very simple. The essential time consuming part of the process is the sterilization. Although this has now been reduced from the boiling on six consecutive days to three, it is still an important element in laboratory work especially where students are present but two or three days, usually alternating, in each week.

During the past two terms I have made a considerable number of experiments for the purpose of determining if it is necessary in order to secure complete sterilization to boil media, when distributed in small quantities in tubes, for three consecutive days. In these experiments I have found that one boiling for a slightly longer time, thirty minutes, seems to be all that is necessary to sterilize bouillon, nutrient agar and nutrient gelatin distributed in either small or large tubes. After distributing the medium the tubes were put in a closed water bath and boiled vigorously for thirty minutes. At the expiration of that time they were taken out and placed in an incubator where they were allowed to remain for several days, when it was a simple matter to sort out and reject any tubes that may have been contaminated. As will be seen from the appended tables, giving the results of these experiments, contaminations have been very rare. In fact they have not been much if any more numerous than they were when the three regular boilings were employed. Although several of the agar and gelatin tubes were not sterilized, they were contaminated with a spore

bearing bacillus which has not infrequently appeared in media boiled for ten minutes on three consecutive days.

STERILIZATION OF BOUILLON WITH ONE BOILING.

Date.	Number of tubes.	Amount in each tube.	Time boiled.	Days in incubator after boiling.	No. of tubes contaminated.	Remarks
Jan. 9, 1897	40	7 c. c.	30 min.	7	0	.....
Jan. 14, 1897	80	7 c. c.	30 min.	7	0	.....
Jan. 14, 1897	14	25 c. c.	30 min.	7	0	Fermentation tubes with one per cent. glucose.
Feb. 5, 1897	32	7 c. c.	30 min.	7	0	.....
Feb. 11, 1897	35	7 c. c.	30 min.	6	0	.....
Mar. 5, 1897	46	7 c. c.	30 min.	7	0	.....
Apr. 6, 1897	45	7 c. c.	30 min.	5	0	.....

STERILIZATION OF AGAR WITH ONE BOILING.

Date.	Number of tubes.	Amount in each tube.	Time boiled.	Days in incubator after boiling.	No. of tubes contaminated.	Remarks.
Jan. 22, 1897	50	7 c. c.	30 min.	7	3	Each of the three tubes contained a spore bearing bacillus belonging to the <i>B. subtilis</i> group.
Jan. 27, 1897	48	7 c. c.	30 min.	7	2	Same as above.
Feb. 5, 1897	81	7 c. c.	30 min.	6	0	.....
Feb. 13, 1897	14	7 c. c.	30 min.	7	0	.....
Mar. 16, 1897	25	7 c. c.	30 min.	7	0	.....
Mar. 27, 1897	41	7 c. c.	30 min.	7	0	.....
Apr. 6, 1897	40	7 c. c.	30 min.	7	0	.....

STERILIZATION OF TUBES OF AGAR CONTAINING A LARGER QUANTITY FOR MAKING PLATE CULTURES.

Date.	Number of tubes.	Amount in each tube.	Time boiled.	Days in incubator after boiling.	No. of tubes contaminated.	Remarks.
Dec. 29, 1896	30	12 c. c.	30 min.		0	Left at room temp. for 10 days
Jan. 27, 1897	26	15 c. c.	30 min.	7	0	.....
Feb. 5, 1897	15	15 c. c.	40 min.	6	0	.....
Mar. 16, 1897	35	18 c. c.	30 min.	7	0	.....
Mar. 27, 1897	43	18 c. c.	30 min.	7	3	Spore bearing bacillus belonging to the <i>B. subtilis</i> group.
Apr. 6, 1897	40	18 c. c.	30 min.	7		.....

STERILIZATION OF GELATIN WITH ONE BOILING.

Date.	Number of tubes.	Amount in each tube.	Time boiled.	Days in incubator after boiling	No. of tubes contaminated.	Remarks.
Dec. 29, 1896	30	12 c. c....	30 min....		0	Left at room temp. for 14 days
Feb. 19, 1897	30	15 c. c....	30 min....	7	0	.....
Mar. 18, 1897	15	18 c. c....	30 min....	7	0	.....
Do.....	25	7 c. c....	30 min....	7	1	Contained a spore bearing bacillus belonging to the <i>B. subtilis</i> group.
Mar. 23, 1897	10	18 c. c....	30 min....	7	0	.....
Do.....	36	7 c. c....	30 min....	7	0	.....
Mar. 25, 1897	35	7 c. c....	30 min....	7	0	.....

If spore bearing bacilli are present in large numbers more difficulties might be experienced. But ordinarily if the medium is prepared with proper care and distributed as soon as filtered, in sterile tubes and boiled at once very few contaminations are likely to occur.

The time that must elapse before the medium can be safely used is not so much shorter than when the customary method is employed but the time actually spent in sterilizing is much shorter. In a crowded laboratory this is important. It probably is not necessary to leave the media in the incubator from five to seven days as I have indicated in the above tables for in every case of contamination the growth took place within the first twenty four hours.

I am not prepared to say that this method is the best or that it is safe for all kinds of work, but it has proved to be well adapted to the needs in a student laboratory and to save much valuable time for both the student and the teacher.

Prof. Hankine, one of the leaders in sanitary work in India, contracted plague a few weeks ago, but fortunately the attack was not severe and he recovered. He was inoculated with Haffkine's serum.

The Index of Refraction.

BY DR. B. L. RAWLINS,

DALLAS, TEXAS.

A ready, fairly accurate and practical method of determining the index of refraction of liquids, and transparent solids with plane parallel sides, would be of interest possibly to the majority of workers.

The works on optics and the elementary treatises on how to work with the microscope, apparently lose sight of the necessity for something practical, in giving us complicated formulas and describing expensive instruments for determining this index.

It is with this apology that the writer offers this article, feeling sure that the same thing must have occurred to many, although he has never seen this method published.

As in passing from a rarer to a denser medium, a ray of light is deflected in a definite direction from its immergent course, likewise is the apparent distance through the denser medium less than the real distance.

As the ratio of the sin. of the angle of incidence to the sin. of the angle of refraction is constant, likewise is the ratio of the apparent distance through the denser medium to its real distance invariable.

From experiment it is found that as many times greater than the sin. of the angle of refraction is the sin. of the angle of incidence, so many times greater is the real distance through the denser medium, than the apparent distance.

For example the angle of refraction of water is 1.333: the apparent depth of a volume of water one and one-third feet in actual depth, is one foot.

Assuming that the worker interested in this subject is possessed of a microscope with accurate adjustment and a graduated micro-millimeter fine adjustment screw, he

needs but a slide with a flat cell cemented on it, and a plate cover glass in order to do the work. Perhaps the most convenient thing is the slide that goes with the Zeiss-Thoma blood counter. This has a circular cell cemented onto the slip, with a central cross lined disc, which forms an elevated platform in the centre of the cell, leaving a groove to catch any excess of liquid, in order that it may not flow between the top of the cell and cover glass.

In making the examination, the rules accompanying this instrument must be strictly regarded, in order to insure direct contact with the cover and top of cell. That is, when a minute drop has been placed on the platform and covered with the accompanying plate glass cover, the newtonian rings must appear, otherwise a bit of dust or something has prevented perfect contact between cell and cover. The depth of the cell in this instrument is convenient for calculations, as it is exactly 10 microns.

Procedure. Dust carefully the cell and cover glass with a soft lens brush. After putting the slip on the stage of the microscope (under a 1-5 or D objective for convenience in accurate focussing) the cover is put in place with a pair of forceps, pressed down centrally with the ball of the finger. The finger print made is of the greatest use. If the Newtonian rings are apparent, all is well; if not, try again. Turning the zero mark on the m. m. fine adjustment screw to the pointer, focus to the top of cover glass with coarse adjustment. A little patience allows one to do this, and it is much more convenient. This done, focus with the fine adjustment, noting the distance on the m. m. scale, until the top of the cross lines of the counter are in perfect focus. This distance represents the depth of cell, plus cover glass equal m. Removing the cover and pressing between the fingers, focussing on top and on bottom gives apparent (which is all required,) thickness of cover equal n.

The difference, m minus n equals a and equals depth of cell filled with air.

In like manner a drop of the liquid whose index of refraction is to be determined, is placed in the cell and the cover applied as before and pressed down with the finger. Let us suppose it is water, and that the equation for air substituted is 30 microns minus 20 microns equal 10 microns, or the depth of the cell filled with air. A equals 10 microns.

Now, m minus n equals b and equals depth of cell filled with water. Substituted we have 27.5 microns minus 7.5 microns. B equals 7.5 microns. A divided by b equals 10 divided by 7.5 which equals 1.333 the index of refraction of water.

For obtaining the index of transparent solids with plain sides, as for instance of cover glasses or slips, the apparent depth is obtained as before, the real thickness measured with the cover glass gauge or calipers. Their ratio is the index.

It is not within the province of this article to suggest the important or varied applications attendant on the determination of this index, but the writer will feel highly repaid if it is of interest to any of the readers of the Journal.

EDITORIAL.

Prof. Edson S. Bastin.—The death of Prof. Edson S. Bastin means a severe loss to the body of American scientists. He was one of the most faithful workers in pharmacy. For the last two years he has devoted himself so unceasingly to microscopical work outside of the hours devoted to instruction, that he has virtually allowed himself no proper time for rest, and as a matter of fact, has almost worked himself to death. His work on the anatomy of plants of the pine family has been recognized as of great importance here and abroad.

Inks.—Dr. Marpmann of Leipzig, has recently published the results of the microscopical examination of 67 samples of ink used in schools. Most of these inks were made with gall-nuts, and contained saprophytes, bacteria and micrococci. Nigrosin ink, taken from a freshly opened bottle, was found to contain both saprophytes and bacteria. Red and blue inks also yielded numerous bacteria. In two instances Dr. Marpmann succeeded in cultivating from nigrosin ink a bacillus which proved fatal to mice within four days. This ink had stood in an open bottle for three months, and the inference drawn from the inquiry is that ink used in schools should be kept covered when not in use.

A Water Microbe.—One of the unaccountable phenomena of the Black Sea has been explained by the bacteriologists. Since time out of memory it has been a well-known fact that there were no deep-sea fish in the body of water mentioned. Away back in 1850 the scientists made an investigation and found that fish could not live at a greater depth than 200 fathoms in the water of the Black Sea on account of the presence of a superabundance of sulphuretted hydrogen. Time and again the waters were stocked with deep sea fish, but all died on account of the poisonous gas which was generated in such quantities in those portions of the water which should have been their natural habitat. It was known that the gas was at the bottom of all the trouble, but exactly where the gas came from was what so puzzled the investigators. The microbiologists finally took the matter in hand and a recent observer now announces that the gas is generated by the countless number of microbes which make their home in the ooze at the bottom. This microbe decomposes mineral sulphates and has been named *Bacillus hydrosulfuricus ponticus*.

One more indictment is added to the many against the house-fly. Yersin communicated plague to guinea-pigs by the inoculation of sterilized water in which flies found dead in the laboratory had been rubbed up.

MICROSCOPICAL MANIPULATION.

A New Culture Medium for the Diphtheria Bacillus.—

Joos (Jour. Med. de Bruxelles, May 7, 1896) has had occasion to make a large number of bacteriological examinations in cases of suspected diphtheria. He finds that the ordinary methods of cultivating Löffler's bacillus are not satisfactory; he also finds Deycke's method unsatisfactory, as it hinders the growth of the Löffler bacillus, and stunts the colonies. Joos has modified Deycke's medium, and claims to have found a material on which no other bacillus except that of diphtheria will grow normally. He prepares "albuminate of soda" by adding saturated caustic soda solution to serum of strong alkalinity, placing the mixture in a vapor bath for half an hour, and filtering. To the filtrate is added pure hydrochloric acid till the reaction is neutral or very slightly alkaline. If too much caustic soda was not added at first, the substance is now ready for use; otherwise the excess of sodium chlorid requires to be dialyzed out. On evaporating to dryness, a powder is obtained which is readily soluble in water, and which is not coagulated by heat. The nutritive medium is prepared by adding to 1000 gr. of peptonized bouillon 20 gr. each of agar and "albuminate of soda." The mixture is placed in the autoclave at a temperature of 115 degrees to 120 degrees C. for half an hour; then 15 c.cm. of caustic soda are added, and the whole put back in the autoclave for fifteen minutes, after which it is filtered in the vapor bath. After filtration, it is sterilized at 120 degrees C. in the autoclave for three quarters of an hour, when it is ready for the preparation of the plates. It is claimed by Joos that streptococci will not grow on this medium at all, and staphylococci but feebly, while Löffler's bacillus grows luxuriantly in from six to twelve hours. If the presence of streptococci is to be determined as well, the amount of "albuminate" is to be reduced to one and one-half per cent. At the end of fifteen to eighteen hours small colonies of streptococci may be seen among the large and well-developed patches produced by the diphtheria bacillus.

Preservation of Urinary Deposits.—Heretofore the subject of mounting and preserving urinary deposits has received comparatively little attention, perhaps from the fact that no suitable method has been discovered. Specimens of urinary deposits, when properly mounted, are an excellent means of demonstrating the various pathological elements found in urine. We are indebted to Gumprecht (*Centralblatt f. Inn. Med.*; *British Medical Journal*, September, 1896) for the following method, which he finds to be superior to chloroform or glycerin: A deposit is first obtained by means of the centrifuge. This deposit is then placed in a concentrated solution of corrosive sublimate and centrifugalized again. It is then washed, and preserved in a solution of formal. The hardening in sublimate may be omitted if no red blood-cells are present. If there is much albumin present, the deposit may be washed with advantage in a normal saline solution. If the urine contains urates, the deposit should be washed with warm water or a concentrated boracic solution. The washing of a deposit by means of the centrifugal machine has long been in use in the laboratory. No washing is necessary if sublimate is not used. The strength of the formal solution may vary from two to ten per cent. The author says that urinary deposits thus preserved can hardly be distinguished from fresh deposits. Cover-glass preparations may be made, but it is well to wash off the formal. The cells maintain their shape, and the nuclei of the cells take the stain in the usual way. Casts, and especially red blood-cells, are well preserved. Fat is readily distinguished. Micro-organisms are easily recognized even when unstained.—*Modern Medicine.*

BACTERIOLOGY.

Virulent Diphtheria Bacillus of the Conjunctival Sac.—

Spronck (*Deutsche Med. Woch.*, 1896, No. 36) undertook to learn, by means of the specific protective property of Behring's serum, whether the diphtheria bacillus and

those slightly virulent or non-virulent bacilli which resemble it are the same species of bacterium. Out of seven cultures from the pharynx, there were five which produced a local edema and general disturbance in the guinea-pig when injected subcutaneously. Guinea-pigs which had been injected with a relatively large dose of anti-diphtheritic serum were not rendered immune to the effects of these cultures but the same dose of virulent diphtheria culture was without effect.

He also experimented with three cultures of the bacillus, resembling the diphtheria bacillus, isolated from typical cases of xerosis conjunctivæ. Subcutaneous injections, in guinea-pigs of medium size, of one to three cubic centimeters of a 24-hours bouillon culture, produced edematous swellings which disappeared after forty-eight hours, with loss of appetite, weakness, etc. Guinea-pigs which were rendered in a high degree immune to the diphtheria bacillus showed no increased resistance to the bacillus of xerosis.

The author concludes that the anti-diphtheritic serum is useful in differentiating the diphtheria bacillus from the slightly virulent xerosis bacillus. He thinks the results with the anti-diphtheritic serum leave no doubt that the xerosis bacillus does not belong to the true species of diphtheria bacilli but should be classed with one or more distinct varieties of bacilli.

He does not claim to settle the question as to whether every bacillus which loses its effects in the presence of the protective property of the anti-diphtheritic serum is the true diphtheria bacillus, but leaves it to further research.

Whether the diphtheria bacillus with slight virulence is a common inhabitant of the conjunctival sac, he thinks can be easily determined if all or most of the cultures possess sufficient virulence to allow of control investigations. He believes, however, that most of such are organisms which belong in the class of xerosis bacilli. He does not deny that the true diphtheria bacillus may be found in the con-

junctiva in specific diphtheria and other infections and in the normal conjunctiva on rare occasions.—Medicine.

On the Xerosis Bacillus.—J. Eyre (Journal of Pathology and Bacteriology, July, 1896) gives a report of interesting studies upon the bacillus of xerosis conjunctivæ. Twelve cases were examined, six being in males and six in females. Of the females, two were classmates and the remaining four were members of one family—an interval of about a week was noted between the onset of the attack in the mother and the three children. The cases were characterized clinically by a number of small, irregularly oval-shaped, pinkish, edematous bodies, situated in the lower conjunctival fornix, and not encroaching upon the ocular conjunctiva. Injection of the conjunctival vessels, lachrymation, photophobia, inability to continue at work requiring close observation, distress at night and when using artificial light, were among the symptoms.

In contrast to these cases he reports a case of true conjunctival diphtheria. The patient was a boy aged four years. Both eyes were affected, the lids being painful, red, and swollen, and separable with difficulty owing to the brawny infiltration of the subcutaneous tissue. The ocular conjunctiva was chemosed; the palpebral portion congested and thickened, presenting patches of a pale grayish-yellow membrane, which stripped off easily, leaving a raw bleeding surface.

The differences between the xerosis bacillus and the diphtheria bacillus are given as follows:

1. After inoculation of the secretion upon blood-serum, colonies of the xerosis bacillus do not appear within thirty-six hours; those of the diphtheria bacillus appear in sixteen to eighteen hours.
2. When grown in neutral bouillon or milk, the xerosis bacillus never gives rise to an acid reaction; the diphtheria bacillus invariably does.
3. When grown upon potato, the xerosis bacillus rapidly degenerates and dies; the diphtheria bacillus grows with more vigor and to a greater size than on any other medium.

4. When grown upon 10 per cent gelatin, colonies of the xerosis bacillus are not visible to the naked eye within forty-eight hours; the colonies of diphtheria bacilli can be recognized in twelve to twenty-four hours.

5. The invariably innocuous nature of the bouillon cultures of the xerosis bacillus, when inoculated into the subcutaneous tissues of animals is susceptible to the bacillus of diphtheria.

As to the exact nature of the xerosis bacillus—whether it be a non-virulent and slightly altered species of the bacillus diphtheriæ, or a totally separate and distinct bacillus—it is impossible at present to decide.

Leucocytes and the Bactericidal Action of the Blood.—Hahn (Arch. f. Hyg., vol. xxv, p. 105) has investigated the action of blood serum and also the pleural exudation of rabbits. The leucocytes in the latter are destroyed by freezing. He found that the exudate had a more powerful bactericidal action upon *Staphylococcus pyogenes aureus* and bacillus typhosis than the blood serum or the defribinated blood of the same animal; and since the leucocytes were destroyed, the action cannot depend upon phagocytosis in Metchnikoff's sense of the term. The author made experiments with Lichenfeld's histin-blood, in which the leucocytes remained unaffected, in order to determine whether the bactericidal power depends upon the destruction of leucocytes or upon substances secreted by the leucocytes while still alive. He came to the conclusion that the latter is the more probable explanation.

Bubonic Plague Bacillus.—Dr. Alvah H. Doty gives a full account of the history and germ of the bubonic plague. In the year 542 Egypt was considered the home of the plague. Between 660 and 680 England was invaded. In 1334 it was brought from the East, where it was supposed to have had its origin. Sicily 1346, Norway 1351. The mortality was enormous. During the eighteenth century the plague existed only in Eastern Europe, Asia and Africa. A slight outbreak occurred in Delmatia in 1840, and a severe one on the Volga, in the province of Astrakan in Russia, 1878-79.

Since then it has not appeared in Europe. In 1894 it occurred in Hong Kong and Canton; in the latter place 180,000 people died.

The credit of discovering this organism is due to Yersin and Kitasato, who worked independently in their investigations. The organism is known as *bacillus pestis bubonice*. It is found in large numbers in the buboes characteristic of this disease, in the lymphatic glands and occasionally in the internal organs. It occurs in the blood only in acute hæmorrhagic types, shortly before death.

The organism has been cultivated in artificial media and disease resembling it has been produced in lower animals. It is pathogenic to many animals and during epidemics rats, mice and flies die in large numbers, the disease being apparently transmitted through them.

It is a short and thick bacillus, somewhat motile, with rounded ends, somewhat motile, and stains with aniline dyes, the ends coloring more deeply than the middle. It does not form spore. It grows well in blood serum, in the form of white moist, iridescent colonies. It grows slowly in gelatin but rapidly in glycerin agar, forming a grayish white surface growth. In bouillon it grows in a very characteristic way, resembling the growth produced by the erysipelas organism. The culture medium appears clear, with white granular deposits on the walls and in the bottom of the tube.

It is pathogenic for rats, mice, guinea pigs and rabbits, which die usually within two or three days after inoculation. The bacillus soon loses its virulence when grown in artificial media. The virulence of the organism is increased by successive inoculations in certain animal species.

We are indebted to Yersin, Calmette and Borrell for the antiplague serum. Animals are immunized against the attacks of the organism by repeated intravenous or intraperitoneal injections of dead cultures or by subcutaneous inoculation. A horse was immunized in about six weeks. The serum afforded protection to small animals after subcutaneous injection of virulent cultures, and even cured

those that had previously been infected if administered within twelve hours after the inoculation. Yersin has recently reported the successful treatment of a man who was attacked by a severe type of the disease. The French Consul at Hong Kong performed the same operation upon two other pupils at the Catholic Mission with success.

Baldness Microbe.—One of the physicians at a hospital in Paris has, it is stated, discovered a microbe of the skin which accounts for baldness. It appears that baldness attacks those whose skin exudes an excessive amount of fat or oil, and the parts affected are washed with ether and other solutions, myriads of small microbes may be seen similar in length (!) to the tuberculosis bacillus. This particular skin microbe varies in size according to its age and position. For instance, on the scalp it is smaller than on the face or the body, but the structure remains always the same. The doctor has inoculated a sheep and a rabbit with the skin microbe at the Pasteur Institute, and he will make known the results of his experience to the Society of Dermatology. It is stated that there are three or four therapeutic agents capable of destroying the fatty substance of the skin complained of.

MEDICAL MICROSCOPY.

The Klebs-Loeffler Bacillus in Apparently Normal Throats and Noses.—W. H. Gross (University Medical Magazine, October, 1896) presents an interesting report of some observations made in the Children's Hospital of Boston. During six months ending June 1, 1896, culture examinations were made from the throats and noses of all cases entering the hospital; two cultures, twenty-four hours apart, being taken on admission, and subsequently repeated once weekly as long as the case remained in the house, unless the Klebs-Loeffler bacillus was found, in which case daily examinations were made until three successive negative cultures, twenty-four hours apart, were obtained. The work was undertaken with the object of

preventing outbreaks of epidemics of diphtheria, which in past winters had occurred in this hospital with most disastrous results.

Out of 316 cases examined, 26 at one time or another showed the presence of the Klebs-Loeffler bacillus. Two of these had clinical diphtheria, so that out of 314 normal throats and noses, 7.9 per cent contained the bacillus of diphtheria. The average persistence of the bacillus on the mucous membrane was fifteen days; the shortest period one day, the longest 103 days. The nose was the principal habitat in 65 per cent and the throat in 35 per cent. The degree of virulence possessed by the bacilli in the various cases was not determined.

Antitoxin in Diphtheria.—The American Pediatric Society are about to undertake a second collective investigation of antitoxin, and they now ask that records of cases of diphtheria involving the larynx, whether operated or not, occurring in the United States, be sent to the Secretary, W. P. Northrup, M.D., 57 East Seventy-ninth street, New York, N. Y.

The following sums up the conclusions of the Society based on the first investigation:

Dosage.—For a child over two years old the dose of antitoxin should be, in all laryngeal cases with stenosis, and in all other severe cases, 1500 to 2000 units for the first injection, to be repeated in from eighteen to twenty-four hours if there is no improvement; a third dose after a similar interval, if necessary. For severe cases in children under two years, and for mild cases over that age, the initial dose should be 1000 units, to be repeated as above if necessary; a second dose is not usually required. The dosage should always be estimated in antitoxin units, and not of the amount of serum.

Quality of Antitoxin.—The most concentrated strength of an absolutely reliable preparation.

Time of Administration.—Antitoxin should be administered as early as possible on a clinical diagnosis, not waiting for a bacteriological culture. However late the

first observation is made, an injection should be given unless the progress of the case is favorable and satisfactory.

Bacteria in the Urine in Non-bacterial Febrile Disease.

—Chvostek and Egger (Wiener Klin. Woch., 1896, No. 30) report the occurrence of bacteria in the urine in paroxysms of malaria and in fever produced by injections of tuberculin. As the experiments were conducted in such a way as to exclude the usual causes of error in such observations, the authors believe that fever serves in some way to favor the excretion of micro organisms, though no bacterial disease in the usual sense exists. They suggest that this may be simply the exaggeration of a process which must occur at times in healthy persons. Bacteria gain entrance to the blood in various ways, perhaps most frequently by way of the lymphatics, and are finally excreted with the urine. These germs are probably more or less lowered in vitality, so that they cannot often be cultivated successfully; but in fevers such as the authors worked with, the excretion is more rapid. These and other observations show that the presence of non-specific bacteria, especially the *Staphylococcus albus*, in the urine cannot be looked upon as of great importance, and that other facts must be brought forward in order to prove their relation to the disease.

BIOLOGICAL NOTES.

The Scandal on Oysters.—At the recent meeting of the British Medical Association, Professors Boyce and Herdman took pains to show what persons familiar with the natural history of the oyster have known all along, that it is not a scavenger, as some people have ignorantly alleged but a cleanly and docile animal of slow movement and over-trustful of its pampering caretakers. Consequently it has been most foully treated. The professors cited and verified facts that had been before stated—namely, that when oysters were laid down in pure water a natural process of

cleansing took place, and previous sewage contamination was thus entirely got rid of. This result forms the highest possible argument in favor of the absolute purity of the surroundings of oysters during their cultivation or after being laid down in special beds for fattening purposes.

With regard to the germs of typhoid fever in sea water or in the tissues of the oyster, it was shown that they are viable for fourteen days in sea water at 35 degrees centigrade, while in cold sea water they may live for twenty-one days; and when large quantities of the microbes are added to the water, their presence may be demonstrated for a longer period than when small quantities are employed. It thus seems that the bacilli do not actually breed or multiply in the sea water at all. Infection from this source, therefore, is from germs that have entered the water, and not from their descendants and progeny. It was also demonstrated that the typhoid microbe does not increase either in the body or in the tissues of the oyster. Where oysters are infected with typhoid germs and placed in a stream of pure sea water, the bacilli disappear in from one to seven days. The oyster evidently utilizes its pure environment to get rid of its unwelcome and uninvited germ guests.

Distinctions Between Human and Animal Blood.—On mixing the blood in question with a little bile, there are formed crystals not exceeding 0.003 meter in size. Those of a man are right rectangular prisms; those of the horse, cubes; of the ox, rhombohedrons; of the sheep, rhombohedric tablets; of the dog, rectangular prisms; of the rabbit, tetrahedrons; of the squirrel, hexagonal tablets; of the mouse, octahedrons; of common poultry, cubes modified at their angles, etc.—Scientific American.

MICROSCOPICAL NOTES.

The Night Lunch Wagon.—Mr. John F. Hurley, president of the water board, of Salem, Mass., who has been indefatigable in promoting a good water supply, has now

called attention to a matter which effects the public health in a different degree. Disclaiming any intention of needlessly interfering with any person's means of livelihood, he has protested against the licensing of night lunch wagons, on account of the liability of the spread of disease by this means. These wagons are a familiar sight in the cities and larger towns. Either they are driving about the streets or they occupy a stand, night after night. Mr. Hurley has interested himself to inquire into their operation and finds when ready for customers the water supply of a wagon consists of about two gallons of water in a bucket. During the night several hundred cups of coffee and mugs of milk are sold and emptied into mouths many of which are dirty and diseased, some foully so. The cleansing of the mug or cups consists of a rinsing in the bucket of water and a wipe with a towel that does duty for the entire night. We must agree with Mr. Hurley that probably no better method of spreading disease can be found than the practices he describes, and the subject is one which should receive the attention of the board of health in the cities where such a menace to public health exists.—The Engineering Record.

Infection by Pets.—Cats have been suspected of conveying the infection of diphtheria, and scarlet fever has been traced to them. To this may be added (Chicago Medical Record) the unwelcome news that a health officer has reported a case of smallpox brought about in the same way; that is, by a cat from an infected house carrying the disease to a neighboring house.

Another case is reported in *La Medecine Moderne*, "of a seamstress who was in the habit of allowing her dog to lick her face. She was attacked one day with a severe inflammation of the right eye. Oculists were consulted, but their treatment was unsuccessful; and owing to the fact that inflammation of the left eye was beginning, the right eye was cut out. In it was found a tapeworm, which the dog had probably picked up while licking some less pleasing object than his mistress's face.

"The danger of the transmission of parasites by dogs, who are well known to be indiscriminate in choosing objects for the exercise of their tongues, to the hands and faces of their masters, would seem to be a great one. It is remarkable that accidents of the kind related happen as rarely as they do."

MICROSCOPICAL SOCIETIES.

Royal Microscopical Society.—At the last meeting of the society, Mr. F. Enoch, F. L. S., F. E. S., showed under microscopes a unique collection of specimens of "a much neglected family," viz., the mymaradæ. These insects, some of them much tinier than a grain of sand on the seashore, are egg-parasites, that is to say, they prey on the eggs laid by other insects—some of them in the live bodies and still other minute denizens of London trees. The researches conducted by Mr. Enoch have brought to light some eight hitherto unknown genera, and latest was discovered at Holloway. Mr. Enoch prepares, mounts, sketches and photographs the specimens for which he hunts by night and by day in London and the suburbs, and the exhibition which he arranged was of much interest.

New Jersey State Microscopical Society.

Monday, April 26, 1897.—At Kirkpatrick Chapel, Rutgers College Campus, New Brunswick, N. J., was held the twenty-eighth anniversary meeting of the New Jersey State Microscopical Society. An efficient committee, chairmaned by Dr. Chester had striven to make the meeting attractive to the public and had signally succeeded.

Dr. Julius Nelson, President of the Society, made a brief speech of welcome and introduction. He called attention to the fact that the Society is not among the least educational factors in this city. Meetings are held, month by month; popular subjects, easily understood, are treated of by specialists; and the public is always welcome, admission being given gratis. The facilities offered are unique in this city.

"The microscope," said Dr. Nelson, "has made greater revelations than the telescope. The views which you shall behold this evening, projected from a polarizing apparatus perfected by Dr. Van Dyck, have not been shown to an audience of this kind before."

Dr. Van Dyck then explained the polarizing projection lantern, giving the theory of light vibrations and telling the effects of interference between waves of light. Polarization is acquired when all parts of a medium move alike and in the same direction. By means of a bundle of glass plates, arranged in a certain way, he had perfected the projecting apparatus.

While Dr. Van Dyck managed the lantern, assisted by Frederick H. Blodgett, secretary of the society, Dr. Chester explained the views. They were magnified from the slides 160,000 times, being projected from a one-quarter inch aperture to an area upon the screen of about eight feet.

"Beautiful" is too feeble a word to describe the tints which the rock crystals and the organic particles assumed under polarized light. Again and again, as the more exquisite specimens were shown, the audience gave expression to its delight in applause. When inorganic specimens—crystals formed by chemicals—were projected, much amusement was occasioned. By some arrangement of the apparatus, the crystal "wheels went around," changing their hues the while.

Part II of the scientific entertainment was held in the lecture room in the rear of the chapel. Here were half a hundred microscopes, with specimens well mounted and displayed under both electric and oil light, arranged on tables. The visitors passed up one row of microscopes, peeping into the tubes as they walked, and down the other row. These were the exhibitors and their exhibits:

College Experiment Station; Photo-micrographic Camera

Dr. J. B. Smith; Eggs of the Tape-worm, Head of the Tape-worm, Mouth of the House-fly, Mammalian Sperm, Wing Cover of a Beetle.

Dr. B. D. Halsted; Starch in Cells of Bean Seed, Spores of a Parasitic Fungus, An Akebia Stem, Carnation Rust in a Leaf.

Mr. F. B. Kilmer; Section of Sponge, *Bacillus pyocyaneus*.

Dr. P. T. Pockman; Stomata in Fern Leaf.

Mr. F. H. Blodgett; *Protococcus*, Zoospores of *Draparnaldia*, Mandible of Lady-bug.

Mr. F. H. Blodgett; Wild Flowers.

Dr. W. W. Knox; Foramenifera.

Dr. A. C. Hutton; Pappus of Marguerite.

Prof. C. L. Speyers; Spicules of *Gorgonia*.

Prof. W. S. Myers; Humming Bird Feathers.

Dr. A. H. Chester; Arranged Diatoms.

Mr. J. M. Devoe; Tongue of Beetle, Foot of Spider.

Dr. M. H. Hutton; Fossil Diatoms.

Mr. F. C. Van Dyck Jr.; Pollen of Japan Lily.

Dr. F. C. Van Dyck; Micro-photograph of Plants.

Dr. D. C. English; Section of Human Appendix, Kidney of Mouse.

Dr. H. R. Baldwin; Hair Bulb, Flea, Cheese Mite, Feather of Goose.

Dr. F. M. Donahue; Section of Scalp.

Mr. J. A. Manley; Iron Pyrites.

Dr. Caroline H. Marsh; Section of Spinal Cord.

Mr. L. H. Noe; Platinocyanide of Yttrium.

Dr. Julius Nelson; Frog's Kidney, Human Kidney, Human Hair.

Dr. Julius Nelson; Various Hairs, Various Fibres.

Mr. W. W. Wilson; Root-cap.

Mr. L. T. Ives; Butterfly Scales.

Dr. A. L. Smith; Normal Artery.

Dr. N. Williamson; Pathological Artery, X-ray Photograph of Ibis.

Mr. W. S. Valiant; Casts of *Triarthrus beckii*.

Mr. Thomas Craig has found an apparently new rotifer. The peculiarity of it is in the fact that it is enclosed in a case made of grains of sand and small diatoms.

THE MICROSCOPICAL JOURNAL.

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8. Spring clip for holding the specimen.
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12. Horse-shoe base.
13. Rack and pinion for the sub-stage condenser.
14. Flexible pillar
15. Part of pillar with spiral spring of fine adjustment.
16. Screw of fine-adjustment.
17. Milled head of coarse adjustment.

[From Gage's "The Microscope and Microscopical Methods."]

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On a New Fossil Marine Diatomaceous Deposit in Alabama.

By K. M. CUNNINGHAM,

MOBILE, ALA.

In the issue of this Journal for August, 1896, there appeared a paper giving an account of the results secured by myself from an examination of a rather wide area of strata of Tertiary age undertaken during the month of June 1896. It contained much of interest in relation to the various kinds of microscopic fossil organisms found in the various deposits encountered, and in the same article I referred briefly to the locality around Suggsville. At the time of preparing that paper, I had inadvertently overlooked a few specimens collected near Suggsville. In December last while arranging and labeling specimens of the minerals previously collected I found some small samples of clay. It occurred to me that I had not made a micro-analysis of the same, and with this in view I made a trial test. I found that the material indicated a very interesting deposit of fossil marine diatoms hitherto unknown, and offering much of interest to diatomists and microgeologists in general. After ascertaining this fact it became necessary to secure a relatively large amount of the deposit for the purpose of introducing the same to the notice of all who might desire to study the contents and peculiarities of the new deposit. I therefore found it necessary to communicate with Dr. C. I. Dahlberg, of Suggsville, indicating the situation of the

deposit, requesting him to visit it and send me a quantity of the deposit. Through his kindness I secured some fifty pounds of clay, and after the receipt of the fossil clay I was enabled to make a study of the deposit.

After preparing and examining the equivalent of about fifty slides, I became sufficiently acquainted with the chief characters of the deposit, to enable me to make some comparative deductions with reference to the two principal sources of North American marine fossil deposits. These are generally known and familiar to American and foreign microscopists. Such deposits are known as occurring at Monterey, Cal. and at other sites on the Pacific Coast. The deposits on the Atlantic Coast are found at Nottingham, Md, Richmond and Petersburg Va., and at other points from New Jersey to South Carolina.

As a result of the studies made from a relatively small quantity of the deposit, not amounting to more than a few ounces in the aggregate, I have been enabled to note and tabulate species represented by the following genera: *Amphora*, 5; *Amphiprora*, 4; *Auliscus*, 3; *Aulacodiscus*, 3; *Actinocyclus*, 3; *Actinoptychus*, 6; *Asterolampra*, 2; *Amphitetras*, 2; *Biddulphia*, 6; *Coscinodiscus*, 10; *Craspedodiscus*, 2; *Cocconeis*, 1; *Cyclotella*, 2; *Corinna*, 2; *Diatoma*, 2; *Dimeragramma*, 1; *Diplo-neis*, 3; *Eunotogramma*, 1; *Glyphodiscus*, 2; *Hyalodiscus*, 2; *Hemiaulus*, 2; *Melosira*, 5; *Navicula*, 10; *Pleurosigma*, 3; *Pyscilla*, 2; *Pseudoauliscus*, 1; *Rutilaria*, 1; *Raphoneis*, 2; *Synedra*, 1; *Triceratum*, 6; *Trinacria*, 2;—approximating one hundred species in the aggregate. Associated with the diatoms are additional fossil organic remains viz. some 20 species of Foraminifera, 6 or more of Radiolarians, various sponge and gorgonia spicules, minute spines of echinoderms; stellate spicules, zanthidian spheres, and coccoliths of the chalk resembling those of the recent sea bottom; also crystals

of selenite, and matted crystalline plates. The contents of the deposit offer many points of study interest.

With regard to the richness of the deposit, it becomes only a question of concentration and cleaning as the diatoms are in illimitable numbers, a fragment as large as a lima-bean yielding three or more slides of the usual size. A few peculiarities to be noted by the student are of the following character. The Coscinodiscoidal forms range in size from 1-50 inch to 1-500 inch. Of *Melosira* there are simple closed rings and spiral forms of two or more turns; filaments of *Melosira* having as many as fifteen frustules united together. The *Triceratia* are sometimes found in filaments of three or four frustules in a linear series; spherical *Coscinodiscii* united in pairs in a partial fission or sporangial stage. In these the external hemispheres are fully completed in their reticular surfaces, and the internal halves either perfectly or partially formed, but still enclosed by the sporangial isthmus or hoop. There are *Amphitetras* in prefission union or sporangial stage inclining the frustules to rest on the longer axis. The discoidal forms of all kinds have both valves united to the hoop thus enabling the sculptural details of either top or bottom surfaces to be examined with equal facility in focussing down from one surface to the other or vice-versa.

By this means, it is seen that in all of the *Aulacodiscii* or *Glyphodiscii* having processes or bosses on both surfaces that upon focussing on the upper surfaces, and then through to the lower surfaces the bosses or processes of the lower surfaces bisect the position of the upper bosses. This furnishes a proof that the valves are intact, a circumstance seldom observed in other fossil deposits.

The formation in which this deposit is found is known as gypsous in character. This is owing to the fossil Foraminifera and Diatoms having been mineralized or metamorphosed by two agencies. As a result this tends to

make the cleaning and preparation of the diatoms for study somewhat difficult, or at least a lengthy process. The diatoms are associated with a tenaceous clay matrix very difficult to eliminate by boiling or acid treatment. It may be easily removed by trituration on a soft rubber surface freeing the silicious organisms in abundance; and when they are so freed, it is noted that the surface and interior of the diatoms, especially the *Biddulphia*, and *Actinocyclus*, are densely packed with crystalline bundles. These crystals may be removed by digesting in a mixture of equal parts of sulphuric and hydrochloric acids.

It will also be noted that the larger *Coscinodiscii* are encrusted with blackish spherules of ironpyrite. This can be removed by digesting in nitric acid. When the acid treatment is properly carried out, fair slides may be prepared; but while the requirements noted here may seem formidable or tedious, there is a very simple and direct process that any one can use for all essential purposes of study. For this purpose it is merely necessary to take a piece of the crude diatomaceous clay as large as a lima-bean, wet it with water, place it in the palm of the left hand, and crush it down by the pressure of the fingers of the right hand. Then with the tip of the index finger of the right hand the clay is continuously trituated until no visible small particles or lumps are evident. In the trituration, utilize as much surface of the palm as the hand will permit. The trituated layer is then removed clean from the hand by a pocket knife blade and transferred to a small shallow saucer-like vessel. Water is added, and the paste is dabbled, which will free the diatoms. Allow them to settle to the bottom. The clay water is then poured off carefully, and additional water added a few times to remove the remaining flocculent matter. Then the diatoms may be readily concentrated by a gentle twirling on an incline and tilting to one side. Then a pipette will remove the dia-

toms leaving the larger and coarser portions to the rear. By this means enough diatoms may be secured for a trial study of five or more slides from a very small piece.

This simple process is susceptible of great refinement when properly done. It is the most expeditious way in which to get acquainted with the characters of the deposit; whereas, if the process does not give satisfactory results at the hands of anyone trying it, the customary process of boiling in alkaline, or acid solutions would have to be resorted to. More time is thus consumed and it will scarcely remove the amorphous clay particles which are apt to interfere with a good concentration. I deem the suggestions given herein as pertinent, as the deposit belongs to the category of deposits seldom available, and thus involves experimental tentative processes for its mastery.

The deposit offers a problem to the chemist, viz: to find an acid or combination of acids which will promptly dissolve the compound mineral which has metamorphosed the internal chambers or casts left by the Foraminifera. These shell casts seem to be proof against four of the commoner reagent acids. This problem offers a fine experimental field in the line of micro-chemistry.

If a simple water cleaned slide of the diatoms is placed under the microscope using a 1 inch or a $\frac{1}{2}$ inch objective remarkable chemical phenomena may be observed. By depositing a drop of sulphuric acid on the slide, and then adding a drop of muriatic acid, every foraminiferal form will be violently attacked and torrents of gas bubbles will be thrown off in streams until the internal casts within the foraminifera are exposed. Then the power of the acids is at an end. In the meantime the diatoms will have been materially brightened, revealing the sculptural markings more clearly, where not masked by pyrites. The action of the nitric acid in dissolving the iron mineral does not present any phenomenon of inter-

est as it is rather slow in its action. It seems to be essential in improving the appearance of the preparations.

During the course of my studies of this new deposit I made sketches of all the forms found in the material in the hope of being able to identify the various species, but I found that it was a hopeless task to identify the majority of the species with certainty. I had available one Moller Type Plate, one Getchsmen Type Plate, covering some five hundred species, Kain's Blue print copy of Adolf Schmidt's Atlas (80 plates only) and Wolle's *Diatomaceæ of North America*. All of these were only serviceable as giving the genera alone. The identification of the species with their aid was impracticable. The identification of a species involves the highest critical skill, as indicated in the critical notes attached to Schmidt's figures. So I leave the determination of the species characterizing the Suggsville deposit to those who have a genius for such work.

Immediately on determining that I had found an interesting and new deposit with unfamiliar North American species I at once forwarded to Mr. J. Tempere, of Paris, a specimen of the new earth. He replied that he had received the material, and that he would clean it, and send me a list of the species contained in the same. Six months have elapsed and nothing in reference to the deposit has been received from him. This may show that it takes time to determine with accuracy the species in an unfamiliar deposit.

Incidentally there is an element of scientific romance connected with the Suggsville find which may be stated in this wise: Some ten or more years ago a letter came to me from the Alabama State Geologist, Dr. E. A. Smith, enclosing a letter of inquiry to him from an Atlantic Coast Geologist. It asked whether there was a known fossil Marine Diatomaceous deposit within the bounds of Alabama. The party writing was interested in the sub-

ject from a geologic standpoint. The letter was referred to me for a reply, as I was supposed to be the only person in Alabama that could give the information.

At that date nothing was known of a fossil Marine deposit of any kind, not even a fresh water fossil deposit was known. We only had available the recent Marine Diatoms of the Gulf and the likewise recent fresh water sources. Since that date, the whole Diatom subject is practically exhausted for this locality, and duly put upon record for the benefit of the whole world.

The writer of the letter proved to be Lewis Woolman, of Overbrook, Pa., but latterly of Philadelphia, Pa., who in connection or in collaboration with the Geological Survey of Pennsylvania, has been identified with the study of water-bearing strata or horizons as determined through the study of Artesian well borings and other sources. He is also the originator of an hypothesis involving the assumption that, in the epoch in which the Miocene strata were laid down or deposited, there was deposited along the Atlantic Coastal area a series of Diatomaceous clays, one stratum of which in particular represented by a deposit of at least 300 feet in thickness, and designated by him the "great 300 foot diatomaceous stratum." He had reason to believe it might be traced somewhere all along from New Jersey to the Florida peninsular, and sweeping around to and occupying a portion of the Gulf of Mexico Coastal plain even into Alabama.

It was with the object of collecting data to verify his assumption, that he sought the aid of many correspondents in securing material with which to establish the truth of his hypothesis. I rendered him every reasonable assistance by furnishing specimens. By this means, I put upon record at different periods, the important fresh water deposit of Montgomery, Ala., the fossil marine Diatomaceous clay from the Tampa, Fla. phosphatic area, the pyritized and mineralized diatoms of the Mobile, Ala.,

artesian well area clays 650 below surface, also the Radiolarian and Diatomaceous clays of the Buhrstone Eocene of Alabama and Mississippi, the Holothurian fossil remains of the Clarke Co., (Miss.) marls.

All of these various deposits were but of inconsequential interest to his purposes, as none furnished data of direct use to him. But finally a ray of hope dawned giving new zeal to his hope of finding the missing link in his data requirements, when the 15 feet or more stratum of a marine fossil diatomaceous clay was announced by me as found in the vicinity of Suggsville, Clarke Co., Ala. Mr. L. Woolman since then has had the satisfaction of getting the material wherewith to study the correspondence of the Alabama deposit in its specific forms, with the material and specific forms characterizing the composition of the Miocene clays of the Atlantic Coast.

The Geological Map of the State of Alabama locates Suggsville in the area of the Eocene designated as E. 1., equivalent to the St. Stephens; (Vicksburg; White Limestone, and Jackson) or uppermost member of the Eocene, while the true Miocene should rest upon this group of strata. A comparative study of the Pacific Coast Diatomaceous species and that of the Atlantic Coast species of the Miocene age by me suggests that the Suggsville deposit is more nearly allied to those of the Pacific deposits than to those of the Atlantic Coast.

Foraminifera of the Marine Clays of Maine.—By Frank S. Morton, Portland, Maine. 8 vo., 18pp., 1 plate.

This is a paper extracted from the proceedings of the Portland Society of Natural History for 1897. After a brief description of the localities from which the material was derived, the writer gives the systematic classification of the forms, and bibliographical notes. Students of the Rhizopoda can perhaps obtain a copy by writing to the author at Portland.

Remarks upon the Diatomaceæ.

By J. G. WALLER,

LONDON.

[From the President's Address before The Quekett Club.]

They are ubiquitous, and found everywhere in water, whether in the ocean, or river, or the merest trickling rill. It is an interesting fact, you can in many instances predict the character of what you will find, according to the conditions under which they exist, and they have more than any other organism been favored by constant research. The development of the microscope itself has gone on coincidently with our knowledge. Some diatoms have long been test objects wherewith to examine the highest powers. At the time when Ehrenberg wrote, probably most observers considered with him that they belonged to the animal kingdom; and this view lingered on, finding its supporters even when Andrew Prichard, in 1861, published his admirable compilation on the "Infusoria." Although this is now quite given up, one must not condemn too readily views that were partly suggested by the movements of certain species. Truth is a growth, the result of observation, but it is slow in progress, as the history of opinion on the most important of subjects declares unto us. But, if we assume that the movement of the Naviculaceæ was due to animal nature, the next step was to tell us how this was accomplished. So some observers distinctly saw a ciliated apparatus. This, however is the old story; you can always see what you wish to see, that which your mind has determined; and it is not agreeable to many, perhaps to most minds, to think that your eyes may deceive you. Yet this is a lesson that the microscopist must learn, and it is an important one. The study of the Diatomaceæ continually imposes this upon us. One species has exercised all

the faculties required in minute examination—the *Pleurosigma angulatum*— which has in itself a history singular in the various waves of opinion and attempted demonstration. The markings of its silicious envelope at first presented striæ, which further magnification determined into a series of semi-circular bosses, or at other times, according to other views, so many depressions or apertures. The first was once attempted to be illustrated by a glass tumbler, the sides of which consisted of so many raised bulbs. It was thought that a similar material would be similarly affected by the action of light and thus would prove, or tend to prove, the true construction of the valve. In the theory of elevations, it is not so long ago that arrangements were made in side illuminations by a pencil of light, thus supposing to give a true and artistic light and shade. But, in both these nice experiments, it seemed to be forgotten that they were begun in a foregone conclusion; and, as I have previously said, you naturally, in such a case, see what you wish to see. Certain accidents, fractures, and peculiarities inconsistent with the above-named views, assisted by careful illumination, seem now to have tolerably settled the question to be on the side of apertures, and my predecessor has worked successfully thereto. That this must be the general consent on such markings throughout the *Diatomaceæ* must probably be entertained, though it would be dangerous to affirm that there was no variation from it in the multiform changes of nature.

But the subject has been so admirably worked out and recorded by two papers in our Journal, one by Mr. C. Haughton Gill, April, 1890, in which is well described his mode of preparation of the objects wherewith to determine the structure. Another by Mr. Nelson, in May, 1891, goes into the same matter by the use of high powers, and these papers, showing a working on differ-

ent lines, yet arriving at the same results, commend themselves as conclusive. Nor can we forget the eminent services on diatom structure rendered by our Secretary, Mr. Karop, associated with further ideas on their development. But the diatom will never cease to be of primary importance to the microscopist, as the abundance and variety of its forms even exhaust our imagination, and the volumes written upon it, though numerous, seem to be only forerunners of more to come.

I have alluded to the movements which were once thought to be one of the reasons to indicate animal life, as seen in the Naviculaceæ; but in these forms it is by no means so remarkable as in one less commonly met with, viz., the *Bacillaria paradoxa*, wherein a number of parallel rods slide out side by side on each other, in a manner so curious as to challenge all hypotheses to clearly explain them to us.

But movement can in no way of itself be recognised as a distinction of animal nature, and many examples of the Algae, notably that of *Volvox globator*, go far beyond what is seen in any of the Diatomaceae, and sometimes there is a lingering of opinion here, as to which order the latter should belong. Hesitation of this kind has its value, as it directs attention to the subject, and, finally to a decision. Sponges are now relegated to the animal kingdom, but it is singular that doubts on this should have belonged to modern science; for Pliny, who wrote at the beginning of the Christian era, in his curious compilation, entitled "Natural History," distinctly saw the true place they should occupy.

One might quote eminent names near to our own time who have taken a different view, and it is remarkable, that one of such large experience as the late Dr. Gray, of the British Museum, should have been once on this side and considered the spicules the analogues of the hairs of plants. This comes out in a passage of arms between

him and Dr. Bowerbank, who could not avoid giving so home a trust as to remind him of it. Even after it was generally allowed that they belonged to the animal kingdom, a reservation was made for sometime before the fresh-water sponges were placed in the same position. Observers could not have seen, as I have, the blow-fly hovering over and depositing its eggs, attracted doubtless, by the offensive odor of decomposing flesh.

How the Bacterial Organisms are Studied.

BY J. E. LAMB, M. D.,

WAHOO, NEBR.

The technique of investigating these microscopic plants is manifold. Microscopy alone is inadequate. Identification requires other tests than those afforded by the microscope.

These tests are :—1. Staining agents. 2. Appearance of cultures. 3. Reaction to heat and oxygen. 4. Pathogeny.

1. *Staining agents*.—Watery solution of the aniline dyes penetrates the protoplasm in the cell bodies of most bacteria, yet the tubercle bacillus long eluded observation because it absorbs the solution only when the water is reinforced by some other agent like carbolic acid or alcohol. This microbe is stained with great difficulty, but once stained, it is very resistant to decolorizing agents. Upon these facts, all staining solutions and methods of staining are founded. Some operate slowly, others more rapidly.

In order to appreciate and differentiate the tubercle bacillus, the following solutions and methods of use, are more easy and simple to manipulate than any others with which the writer is acquainted. It is hoped they may prove as acceptable as those you are now using.

I. Fuchsin pulv, 15 grains; Alcohol, 2 drams; Aquæ distillat, 1 ounce.

II. Aquæ distillat, 1 ounce; Liquor ammonia, 3 minims.

III. Alcohol, $1\frac{1}{2}$ ounces; Aquæ distillat, 6 drams; Nitric acid, $\frac{1}{2}$ dram. Aniline green, to saturation.

To stain:

1. Gently press a small part of the most solid portion of the suspected sputum between two cover glasses.

2. During five minutes, place one cover glass in equal portions of solutions one and two, heated till vapor rises.

3. Rinse in water, put a drop of solution three on it, rinse again. If the mount is not a distinct green, put on another drop of solution three, wash again, dry and examine.

The use of the following will also afford gratifying results:

Ziehl's Solution.—Fuchsin pulv, 1 part; Alcohol, 10 parts; Acid carbolic, 5 per cent. sol., 100 parts.

Gabbet's Solution.—Methylin blue, 2 parts; Acid sulphuric, 25 per cent sol., 100 parts.

1. Prepare mount as above, hold high over a flame until dry.

2. Place cover-glass in Ziehl's solution five minutes.

3. Place cover-glass in Gabbet's solution one minute.

4. Dry, examine with oil immersion.

If a hurried diagnosis is unimportant, but permanent mounts desired:

1. Place cover-glass, with dried sputum, in Ziehl's solution twelve hours.

2. Hold in nitric acid, 25 per cent solution, till brownish black.

3. Hold in alcohol five seconds.

4. Hold in water one second.

5. Dip once in two, three, and four, if color is deeper than light pink.

6. Cover mount with Gabbet's solution two minutes.

7. Dry and examine as above.

A one-eighth or one-sixth objective, in other words, the enlargement of 400 diameters, with or without eye-piece multiplications, produces a clear field sufficient for diagnostic purposes.

Alcohol mixed with fresh sputum in order to preserve it, coagulates the albumen which should be softened with a two per cent solution of caustic potash before spreading over a cover-glass. A saturated solution of borax preserves the sputum, liquifies the mucus and does not coagulate the albumen.

Most cocci take Gram's staining readily. The gonococcus, however, being an exception, will not take Gram's method, this being one of its main diagnostic features. It takes all the ordinary aniline stains.

Gram's Solution.—Iodine, 1 part; Potassi Iodidi, 2 parts; Aquæ distillat, 100 parts.

The potash is not indispensable but added to facilitate solution.

2. *The color of colonies.*—If the individual bacteria in any given species be grown on a suitable soil, such as gelatine, bouillon or potato, there results a mass or colony of these minute plants whose size, shape and color afford essential means of differentiating the organisms, and the bacteriologist uses them for recognizing his minute plants just as the chemist uses the behavior of a given substance to identify his still more minute molecules. The streptococcus grows into light gray colonies while the staphylococcus produces bright yellow.

It is only when growing in masses that enough color is formed to be visible. Not infrequently are these colored masses so luminous that they can be photographed by their own light when placed in a dark room.

Indeed, the color of our mischievous microbe played a conspicuous part in many of those natural phenomena which, by their lack of apparent cause, were in early times relegated to the domain of the supernatural. That wavering, cold, uncanny phosphorescent light, seen at night time in putrid plants or by the sea side, is our innocuous microbe. The consecrated wafer placed in the bacteria-laden air of the church edifice over night was found besprinkled with crimson drops in the morning.

The legends are long and tragic of the dire calamities, unmentionable crimes and swift retributions which the strange appearance of our chromogenic microbe was supposed to foreshadow.

A recourse to the supernatural to elucidate all these natural phenomena, is no longer necessary, for to-day, we cultivate and study the tiny bacillus prodigiousus which made the drops of blood, the mingled green and blue phosphorescence.

3. *Heat and Oxygen*.—Like the larger plants, different species of bacteria require different temperatures for their growth. Most all grow well at 60° to 80° F., but the tubercle bacillus ceases to grow below 92° F.

As microbes assume very diverse forms in accordance with the nature of their environments, so also their habitat and mode of life divide them into very distinct classes.

The aerobines can subsist only when they breath the natural oxygen they withdraw from the atmosphere.

The anaerobines live within fluids and living organisms and derive the oxygen necessary for their respiration from the oxygenated substances in which they are found. To the latter class, belong all microbes which provoke pathological changes when introduced into the blood.

4. *Pathogenesis*.—Living animal tissues afford unfavorable soil for bacterial growth. When introduced

into animals a large majority produce no appreciable effect. It is now known, however, that upwards of thirty species are capable of nourishing themselves in animal tissues. No species is pathogenic in all animals but each only in certain kinds. The anthrax bacillus grows well in sheep but refuses to grow when planted in dogs and cats. Hence, the behavior of a given species when inoculated into different animals, is another means of differentiating the organisms.—St. Louis Medical Review.

Algæ found at Roche Abbey, July 11, 1896.

By J. NEWTON COOMBE,

CHAIRMAN OF THE SHEFFIELD SCHOOL BOARD.

The result of my microscopical examination of the gatherings taken from the Sandbeck Lake, and from the 'Wishing Well' and Lake at Roche Abbey, on the occasion of the Yorkshire Naturalists' excursion there on the 11th of July, 1896, has been eminently satisfactory as regards the Diatomaceae, which were the objects of my special investigation. Taking the above-named waters in the order in which they were visited, the well-known water weed (*Myriophyllum*) which grew very freely in Sandbeck Lake, and for a tube of which I am indebted to the courtesy of Mr. J. Stubbins, of Leeds, proved to be a favorite habitat for the following stipitate species of the Diatomaceae:—*Cocconema cymbiforme*, *Gomphonema curvatum*, *G. constrictum*, *Achnanthes exilis*, as well as of the needle-like *Synedra radians*, and the curious tube dwelling and somewhat uncommon *Encyonema prostratum*, the frustules of which last-named species move and pass one another up and down their hyaline mucous-made tubes in very curious jerky fashion.

The parasitic members of the family were well represented on the same weed by *Cocconeis placentula*, which appears like so many small lozengers stuck all over and

along the decayed portions of the weed from which the chlorophyll had departed. I was fortunate enough to find in Mr. Stubbins' gathering two of the frustules of this species in the interesting state of 'conjugation,' although too much attached to the weed to admit of being separated and mounted without injury to the specimen.

Coming to the water of the 'Wishing Well' at Roche Abbey, a dipping from which brought me by my wife some two years ago was found to contain an almost pure gathering of the by no means common filamentous Diatom *Odontidium mesodon* (W. Sm.), I was not a little pleased on this my first personal visit to find floating in the depths of the cool clear well water, a brown silk-worm-silk-like and perfectly pure mass of this interesting alga. After so successful a second find of this particular diatom, which I may say I have never met with in so pure and healthy a condition in any other of the numerous waters which I have examined in various parts of South Yorkshire, the 'Wishing Well' at Roche Abbey ought certainly to be noted by Yorkshire naturalists as a place to be visited by the lovers of freshwater algae in their search for "gems."

Proceeding to the Lake close to the Abbey ruins, it was but a few minutes before I detected upon the surface of this picturesque water a small piece (about an inch square) of that peculiar-looking yellowish-brown scum which to an experienced eye is a certain indication of a 'good find' of Diatomaceae. Upon examination under the microscope the gathering, of which, needless to say, I very quickly secured a tube, proved to be in many respects similar to an extremely fertile one I made some three years ago from the lake at Thoresby. Its special feature was its richness in unusually large frustules, .001" in length, of *Pleurosigma attenuatum*, which, after careful cleaning and boiling in nitric acid, give a brilliant opal iridescence of great beauty under dark ground illu-

mination with a magnification of two or three hundred diameters.

I have been able to identify and to mount in Canada balsam, and also dry, the following 58 species of the Diatomaceae in this one gathering, of which over 40 may be seen on a single slide under a $\frac{5}{8}$ in. circular cover glass :—

<i>Pleurosigma attenuatum</i>	<i>Navicula tumida</i>
“ <i>lacustre</i>	<i>Stauroneis anceps</i>
“ <i>spencerii</i>	<i>Cymatopleura solea</i>
<i>Nitzschia sigmoidea</i>	“ <i>elliptica</i>
“ <i>parvula</i>	“ <i>apiculata</i>
“ <i>amphioxys</i>	<i>Cymbella cuspidata</i>
<i>Tryblionella angustata</i>	<i>Amphora ovalis</i>
“ <i>gracilis</i>	“ <i>minutissima</i>
<i>Surirella biseriata</i>	<i>Diatoma vulgare</i>
“ <i>ovalis</i>	“ <i>elongatum</i>
“ <i>linearis</i>	<i>Odontidium harrisonii</i>
<i>Pinnularia viridis</i>	“ <i>mutabile</i>
“ <i>viridula</i>	“ <i>parasiticum</i>
“ <i>oblonga</i>	<i>Denticula sinuata</i> (?)
“ <i>gracilis</i>	<i>Gomphonema curvatum</i>
“ <i>acuta</i>	“ <i>constrictum</i>
“ <i>radiosa</i>	<i>Cyclotella kützingeriana</i>
<i>Navicula cuspidata</i>	<i>Cocconeis placentula</i>
“ <i>firma</i>	<i>Synedra ulna</i>
“ <i>amphisbæna</i>	<i>Cocconeis lanceolatum</i>
“ <i>elliptica</i>	“ <i>cistula</i>
“ <i>gibberula</i>	“ <i>cymbiforme</i>
“ <i>inflata</i>	<i>Encyonema prostratum</i>
“ <i>affinis</i>	“ <i>cæspitosum</i>
“ <i>cryptocephala</i>	<i>Achnanthes exilis</i>
“ <i>binodis</i> (?)	<i>Eunotia monodon</i>
“ <i>bleischii</i> (?)	<i>Melosira varians</i>
“ <i>veneta</i> (?)	<i>Fragilaria capucina</i>
“ <i>producta</i>	<i>Colletonema neglectum</i>

This time of year and want of rain were not favorable for Desmids, but I came across a few vigorous specimens of the following species :—*Closterium striolatum* (showing very clearly the phenomena of cyclosis and so-called ‘swarming of the granules’ at its extremities), *Pediastrum granulatum*, *Cosmarium botrytis*, while among the less

common of the filamentous algae, I was fortunate enough to find in the Roche Abbey Lake, and subsequently to be able to mount in its own water a well defined gathering of *Oscillaria spiralis*, the curious and unexplained movements of which (as of a headless screw turning continually on its end) were extremely interesting to watch.

Several other and more common species of *Oscillaria* and at least three species of *Spirogyra* and *Zygnema* were abundant in the Lake.—The Naturalist.

Some Facts About *Podisus Placidus*.

BY A. H. KIRKLAND,

AMHEEST, MASS.

During the month of May, 1896, while making field observations in Malden and Medford, Mass., upon the insects known to attack the gypsy moth, *Porthetria dispar*, I found that many of the common predaceous bugs upon emerging from hibernation greedily availed themselves of the food supply offered by the tent caterpillar and destroyed large numbers of this insect. They entered the tents and prey upon the insects.

When feeding, these Pentatomide insert the setæ only, and not the sheath, into the body of the caterpillar. I have watched them very carefully under a hand lens and my observations fully agree with those of Mr. Marlatt, as given in the Proceedings of the Entomological Society of Washington, D. C., Vol. II., p. 249. I have seen *P. placidus* extend its setæ beyond the end of the beak to a distance equal to the length of the last rostral joint. When the setæ are inserted in a strongly chitinated part, the struggles of the larva often pull them from the sheath. In such cases the beak is drawn through the fore tarsi in the same manner that an ant cleans its antennæ, and thus the setæ are forced back into the sheath. I have also removed the setæ of *P. cy-*

niscus from the sheath by means of a fine needle applied along the labrum and have seen them replaced in the same manner. The nymphs of this species were also found attacking the larvæ of the currant sawfly.—Can. Entomologist.

EDITORIAL.

Restriction of Vivisection.—A bill is pending in the U. S. Senate to restrict vivisection. Numerous men who consider themselves accurate observers are opposing it and are representing that it “prevents experiments upon living animals.” They show themselves to be neither accurate observers nor accurate readers for it does nothing of the sort. The bill permits:—(1) All the experiments performed while the animal is insensible to pain, (2) All kinds of surgical operations for testing new methods of surgical procedure, (3) The testing of new drugs or medicines, (4) All kinds of inoculation experiments or bacteriological investigations into the causes of diseases.

Out of 1239 replies from the leading physicians written on this subject, 968 have favored such restrictions as are made in this bill.

Dr. L. E. Rauterberg, late of the microscopical division of the Army Medical Museum has written to a senator as follows:

It was my lot for a number of years to be engaged in the microscopical division of the Army Medical Museum, where I saw practiced the most inhuman and barbarous mutilations of animals under the supervision, and with the sanction, of the United States officer in charge. A desired part or section of the animal would be removed, not under anæsthesia, and the poor beast would be then placed back in its cage or vessel until it suited the convenience of the operator to help himself to another portion so long as the animal would survive these tortures. I have thus seen animals with eyes, sections of brain, and other parts removed and kept in reserve for future experiment for a number

of days, and for the verification and repetition of results obtained and published years ago.

These unnecessary horrors, practiced openly with sanction of United States medical officers, make me think that stringent laws are needed to restrict such proceedings. None should be permitted not calculated to give additional useful information, and then under perfect anaesthesia, and under the supervision of a board of competent men assigned to that duty.

Aware of the possibility of such a condition in a scientific institution located in the District of Columbia and under the control of a government so supine, can any one, knowing of the existence of the above-named abuses, oppose a bill that aims to make such conduct amenable to law?

Nomenclature.—It has always been a source of surprise to us that men will spend so much time over questions of nomenclature and even of classification. The real nature of plants and animals furnishes a great variety of topics for study, and we ought to be able to interest ourselves therein to the exclusion of contests over nomenclature. Nomenclature has usually been based on a few superficial characters and has therefore been liable to incessant change as the result of discovering new facts. All this is a false view of matters and is not scientific.

A scientific nomenclature would be absolutely arbitrary. Let blue things be called *viridis*; let short things be called *longus*; let it be fully understood that pending the acquisition of full knowledge of a form our name is no clue to its characters. We must call it something but it matters not what we call it if we agree upon its name. An arbitrary name once affixed, let no one challenge it or seek to change it. As a sample of the foolishness which men of pseudo-science are forever indulging in, the following quotation will be of interest. It is from the Presidential Address delivered before the London Quekett Club recently and it is proper to apologize for filling our space even to this extent with such nonsense. Mr. Thomas and Mr. Carter are both too sensible men to waste time in frivolity.

Mr. Waller is wiser but might perhaps still better have omitted all allusion to the facts. In another place he shows good ideas of nomenclature by asking whether the names Leidy, Mills, Muleri, Bailey, Capewell, Ramsay, Everett, give any more information than letters or numerals. We far prefer the numerals.

The quotation is as follows:

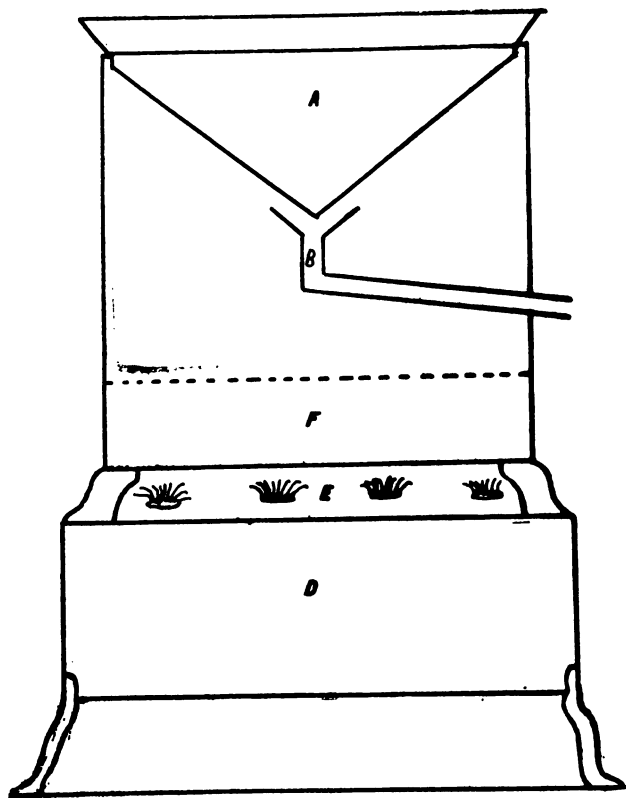
"When Professor Hitchcock, of the United States, was over here a few years ago I gave him a specimen of the *Ditchleys spongilla* for his collection, and others also distributed by or through me found their way to America, and I sent a slide to Mr. Carter. After some time had elapsed I heard that Mr. B. W. Thomas, an earnest worker of Chicago, had found the same variety in the river Calumet, and seeing its identity with that of *Ditchleys*, and finding that, in my description, I had declined specially naming it, he proposed to call it *Meyenia calumetica*. Then Mr. Carter, who had received a specimen from Mr. Thomas, saw that it was identical with that he had received from me turned his attention to the subject, and in an elaborate article in "Ann. and Mag. of Natural History" gave it the name of *Meyenia angustibiotulata*, which title Mr. Edward Potts, in his admirable "Monograph on the Fresh-water Sponges of America," has accepted. Mr. Thomas then feels annoyed that he should thus be superseded, as Mr. Carter had, in the first instance, declared against its being a variety.

For myself, who first discovered it 19 years ago, and might have claimed some voice in the matter, I could not be otherwise than amused at the little quarrel amongst my friends, I having decided against giving the variation any separate name, my views leading me in another direction.

One satisfaction I have, however, gained in the knowledge that the *Spongilla* of the river Calumet is also found growing upon the stem of aquatic plants, as it tends to establish, what one would naturally feel, that similar conditions produce similar results."

MICROSCOPICAL APPARATUS.

Distilling Water.—The most inexpensive method of distilling water is always a practical question. I have an apparatus that I had made which cost but little, and can be made upon a comparatively large or small scale—viz., for a small oil or gas stove to one the size of a cook-



stove, and can be made by any tinner or by any one who can cut tin and use a soldering iron.

Select the stove the size you wish to use, and the diagram will explain the process. A is the compartment for ice or cold water, F the water to be distilled, D the stove. The receptacle containing the ice or cold water should be

made to fit the lower receptacle tightly the same as the cover of an ordinary tin pail, and it will be readily seen that the steam rising from the water underneath coming in contact with the cooled surface above would condense and running down the cone-shaped condenser, drop into the small funnel.

As you will see, this can be made to fit the smallest of oil stoves, or any size larger as desired. It can also be used to make all kinds of flavoring waters by dropping the article, inclosed in a cloth, into the water to be distilled, the strength being determined by the amount put in.—A. J. Harris in *Pop. Science News*.

Note on Color Illumination.—Julius Rheinberg has designed a new form of substage differential color illuminator in order to simplify and facilitate the use of color discs and other stops in the substage of the microscope. It consists essentially of a box, or slide carrier fitted under the condenser, in which there are a number of metal slides which can be pulled out or pushed in quite independently of one another by means of little handles on both sides of the carrier. Each slide has two circular apertures, the one being fitted with a color disc or other stop, the other one being left free. The kind of stop is indicated on the handle. The openings in the slides are so arranged that when the apparatus is closed all the free openings coincide, so that illumination can be effected in the ordinary way. When any other illumination is required it is only necessary to pull out the particular stop, or combination of stops, each stop being in accurate position when pulled out as far as it will go.

In the apparatus there are 19 stops, viz., a dark ground stop, four stops which cause the background to assume various colors, four which cause the object to assume various colors, stops causing the object to be illuminated in different colors from opposite sides in various colors (for showing striations), and one causing the object to be illuminated in different colors at right angles to each other for showing striation etc., similarly situated. There are also

stops for oblique light, several annuli, and a ground glass stop, making a compendium no doubt somewhat too great for the general worker, but which is very serviceable to the experimentalists.

As far as color discs are concerned the stops are so arranged that all those which can be pulled out from the left side of the carrier cause the background to be colored whilst those which can be pulled out from the right side cause the object to be colored.

The number of effects which can be obtained with such an apparatus is unlimited. Mr. Rousselet showed us some weeks ago an ingenious color illuminator, by which, according to a little mathematical calculation, 36 effects could be obtained. By applying a similar calculation to this arrangement it would give some few hundred millions of combinations. This number may be too much even for an enthusiast, and one may prefer to pass over from the quantitative to the qualitative use of the arrangement.

For simplicity in use it cannot be excelled, as it allows of every kind of illumination and stop, being automatically brought into action whilst the object is under examination. The best result can, therefore, be obtained with far greater rapidity than ordinarily, and comparisons can be effected without having to bother about taking stops in and out, as in the ordinary way. The apparatus, although efficient, is needlessly clumsy and heavy. The principle can be easily adopted in a neater form, and made to fit any condenser.

How to Test Objectives is the subject to which but few pharmacists and physicians pay much attention. In a lengthy article on the subject by Dr. A. C. Stokes, published in the *Journal of the New York Microscopical Society*, the writer says: "A severe test, then, or one that should come within the ability of the objective, and so fulfil the conditions of the ideal object for the purpose, is, for a first-class four-tenth-inch, the black dots of *Pleurosigma angulatum* in balsam, and perhaps, and imperfectly, the secondary structure of *Arachnoidiscus Ehrenbergii*; for a one-fifth

inch, the longitudinal lines of *Surirellagemma*, and the secondary structure *Isthmia nervosa* with the postage stamp fracture; for a one-eighth inch or for higher powers up to the owe-twelfth the dotted secondaries of *Craspedodiscus elegans* in certain conditions.

MICROSCOPICAL MANIPULATION.

To Stain the Ringworm Fungus.—Adamson recommends the following method for permanently staining trichophyton:—1. Soak the hair in a 5 to 10 per cent solution of caustic potash on a slide for ten to thirty minutes. 2 Wash in 15 per cent alcohol in water. 3. Dry on slide, and in the case of scales fix by passing through the flame. 4. Stain fifteen to sixty minutes in aniline gentian violet made in the usual way, by adding a few drops of saturated alcoholic solution of gentian violet to aniline water. 5. One to five minutes in Gram's iodine solution. 6. Decolorize in aniline oil two to three hours or longer. 7. Remove superfluous aniline oil by blotting paper. Mount in Canada balsam.—Phar. Jour.

Frozen Sections.—Ethyl chloride might profitably be employed in preparing frozen sections for histological purposes. The results thus far obtained have been exceedingly satisfactory, and, while the method is somewhat expensive, no accessory apparatus is required for the microtome.

Hamilton's method of preparing the tissues for freezing gives good results. Another way of getting the tissue ready is that recently advised by J. Orth. One hundred parts of Muller's fluid are mixed when wanted with ten parts of formol. Small pieces of the tissue under examination are fixed and hardened in this solution in the incubator for three hours. At the end of this time they are removed and thoroughly washed, and alcohol is gradually added until they are placed in 95 per cent alcohol. This latter re-agent must, of course, be removed before the tissue is frozen. If desired, after washing, the specimen

may be at once transferred to the solution of acacia and sugar and frozen. Or, as suggested by H. Plenge the piece may be placed in a 4 per cent formal-dehyde solution for a quarter-of-an-hour, and then frozen in the same solution.

When the tissue has been prepared in some such manner, or even when perfectly fresh, it is placed with some formol and gum acacia fluid upon the specimen-holder of the microtome, and a small stream of chloride, methyl chloride or anesthetic (a mixture of these two re-agents) is played from above directly upon the specimen.

The tube containing the ethyl chloride is held about a foot from the specimen, and moved from place to place until the specimen is firmly attached to its base of support and the upper portion is coated with a few crystals of ice. These crystals are extremely small and delicate, and, therefore, do not injure the tissue so markedly as in some other of the freezing methods. The specimen is readily frozen in from 30 seconds to a minute. Sections are then cut and placed in water or fifty per cent alcohol, and mounted in the usual way. Excellent stained preparations may be prepared in fifteen minutes or less from the time that the tissue is removed from the body.

BACTERIOLOGY.

Differentiation of the *B. coli* from the *B. typhi abdominalis*.—Elsner (Zeitsch. f. Hyg. XXI.) uses plates prepared with Holtz's potato gelatine, to which, after it has been made slightly acid, 1 per cent of iodide of potash has been added. Even on this unfavorable medium the *B. coli* grows freely and quickly, but no colonies of the *B. typhi abdominalis* are visible for 48 hours, and they appear as extremely fine small, shining patches, like drops of water. Controlling his experiments by Pfeiffer's immune-serum process, Elsner always obtained positive results from typhoid stools. Piorkowski, at the Berlin Medical Society June 10, 1896, reported experiments in cultivating these bacilli on agar, bouillon, and gelatine mixed with urine,

which had been suggested to him by the presence of *B. coli* in the bladder. On these media the microbes grew luxuriantly, forming greyish colonies; the *B. typhi* ab. less rapidly in fine transparent patches. In the discussion Elsner said there were plenty of differential signs; the difficulty was to cultivate Eberth's bacillus when it was only present in small numbers—for instance, in water, or mixed with other bacteria, for example, in stools. Ewald, Wolf, and Senator, all had found Elsner's method very useful for the diagnosis of doubtful cases from the stools.—*Brit. Med. Journal.*

BIOLOGICAL NOTES.

Fertilization of the Gymnosperms.—A very important discovery in the mode of impregnation in Gymnosperms made by two Japanese botanists, Professor S. Ikeno and Dr. S. Hirase, which was recently referred to in our pages, supplies a most interesting link between this section of Phanerogams and the higher Cryptogams. Dr. Hirase has discovered that in *Ginkgo biloba*, *Salisburia adiantifolia*, impregnation is effected by antherozoids formed within the pollen-tube. The two nuclei resulting from the final division of the generative nucleus of the pollen-tube are converted, before entering the oosphere, into motile antherozoids, resembling those of the higher Cryptogams, but differing somewhat in form. They are ellipsoidal 82 microns long by 49 microns broad, and contain in the centre a nucleus entirely surrounded by cytoplasm. The main body consists of a head composed of three spiral coils, and a slender tail; to the former are attached numerous cilia. As soon as the antherozoids have escaped through the apex of the pollen tube, they enter the oosphere with a rapid twisting motion. Attraction spheres were observed accompanying the final division of the pollen-tube nucleus. Professor Ikeno has made a similar observation respecting the mode of impregnation in another Gymnosperm, *Cycas revoluta*. The antherozoids are here somewhat larger than in *Ginkgo*; the main body is composed

of four coils, to which are attached a large number of cilia; but the swarming motion was not actually detached. The nucleus is surrounded by cytoplasm. They are found in pairs in the extremity of the pollen-tube, and result from the bi-partition of the genative nucleus. Professor Ikeno states that the structure of the male and female organs in *Ginkgo biloba* and *Cyeas revoluta* at the time of impregnation differs from that observed in any other Gymnosperm in this respect; that while, in the latter, the pollen-tube penetrates deeply into the archegone, in the two species under discussion it never reaches the archegone itself, but remains, at the time of impregnation, at some considerable distance from it. It would therefore be impossible for the pollen-tube-nuclei to impregnate the oosphere without being previously transformed into motile antherozoids. Fertilization is then rendered possible by the copious excretion of a watery fluid by the archegone at the time of impregnation. Further details of this most interesting discovery are promised.

The Wild Nettle is known to contain a remarkable number of useful qualities. The leaf is edible, and the liquid to be obtained from the stalk makes an excellent beverage. The fibre of the stalk may, under treatment, produce an excellent silk. For ages the plant has been used for this purpose in China, where it grows to a height of seven or eight feet. Only recently, however, has the machinery necessary to make the manufacture of this silk a profitable industry been produced. A machine called the decorticator has been invented, by means of which the fibre is stripped off in enormous quantities at a terrific speed. Ramie is the eastern name of the plant.—The Counsellor.

The Foot of the House Fly.—I have succeeded in mounting a specimen of the fly's foot with the pulvilli and tennent hairs stained, and showing, adhering to the ends of the hairs, the viscid globules by means of which the insect is enabled to attach itself to smooth surfaces. I have a fly's foot so mounted and stained with fuchsin,

which may be fairly well shown under a good dry lens. The details, however, are seen better with an oil immersion. Some of the hairs on this slide show the sickle filaments deeply stained and devoid of any adhering substance; others have a small quantity of the gummy fluid held within the hollow of the sickle, while the majority of the hairs are tipped with large globules that could easily be mistaken for permanent knobs or suckers.

The specimen also distinctly shows that the shafts of the hairs fringing the pulvillus do not spring separately from it, but each root or stem forks off near the base, forming two hairs.

I had hoped that staining would have rendered visible the orifice from which the adhering substance exudes, as the opening should be large, considering the size of the attached globules, but no such orifice has been detected. Judging, however, from the way the viscid substance seems in most cases to be held within the hollow of the sickle, it appears possible that a slit may exist along the filament capable of expanding and allowing the substance to exude freely.

The foot in question has been subjected to no cleaning process. Any attempt at such would inevitably clear away the globules adhering to the hairs, as is the case in ordinary preparations.—Eliot Merlin.

Preservation of Flowers.—The following is a very old method of keeping flowers without loss of color: Dry some very fine, pure siliceous sand in the sun or oven; then take a wooden, tin-plate, or pasteboard box sufficiently large and deep, and place your flowers inside erect; then fill the box with sand until the last is about an inch above the top of the flowers. The sand must be run in gently so as not to break the flowers. Cover the box with paper or perforated card board and place it in the sun-light, oven or stove; continuous heat gives the best results. After two or three days the flowers will be very dry, but they will have lost none of their natural brilliancy.—Journal of Horticulture.

DIATOMS.

Reproduction of Marine Diatoms.—Mr. G. Murray records some remarkable observations on the mode of propagation of certain pelagic diatoms collected off the coast of Scotland, chiefly belonging to the genera *Biddulphia*, *Coscinodiscus*, and *Chaetoceros*. In *Biddulphia mobiliensis*, “cysts” were observed within the parent cell, with only slightly silicified membrane, and destitute of the characteristic spines. These cysts appear to have the power of dividing and multiplying before assuming the characteristic parent form. A similar phenomenon was observed in *Coscinodiscus concinnus*, but in this species the protoplasm divides before the production of the “cysts,” two of which were found within the same parent frustule, differing from one another in form and in the width of the girdle-zone. It is not uncommon to find the young colonies of *Coscinodiscus* in “packets” of eight or sixteen; this being apparently the result of further binary division within the frustules, which are found accompanying them in an empty state. The membranes of these young colonies are only very slightly silicified or not at all; and they are, therefore, capable of increasing in size. A similar formation of “packets” of eight or sixteen young individuals within the parent frustule was observed in several species of *Chaetoceros*.—Proc. Royal Society of Edinburgh.

NEW PUBLICATIONS.

A Text Book of Histology. By Arthur Clarkson, Pp. 554, and 174 original colored illustrations. Bristol: J. Wright & Co. Price 21s. net.

In it will be found a full account of the latest, well-authenticated discoveries in the microscopic anatomy of the human body, and a very complete description of the preliminary processes necessary for making either temporary or permanent microscopical preparations of the various tissues. The colored illustrations form a prominent fea-

ture of the book, and although perhaps in a few cases somewhat diagrammatic, it must be conceded that for the most part they show extremely well the principal features visible in successfully stained histological specimens.

Browning's Paracelsus and other Essays.—By J. D. Buck. Robert Clarke Co., Cincinnati. 12mo., pp. 101. 1897.

This little pocket volume containing four short essays is suitable to take along these summer Sundays when going into the woods or fields alone hoping to feel the touch of Nature. To read of Paracelsus, of Genius, of the Music of the Spheres, or of Idols and Ideals while lying on the grass amid the fragrance of flowers or the hum of insects will help to a glimpse of what most men and women never see and do not know to exist—something non-material within, about and around the material form.

I well remember my first experience of the "Music of the Spheres" in Switzerland in 1895. Only he who has heard it, however, will treat this essay as other than imaginative. He who wishes with sufficient earnestness to sense it can perhaps get assistance from this book.

The azure-blue cover and the gilt top make Dr. Buck's book a neat little present. The price is probably not over fifty cents.

Microscopic Researches on the Formative Property of Glycogen. Part I., Physiological. By Charles Creighton, M. D. Royal 8vo, pp. viii.—152. (London: Adam and Charles Black. 1896.) Price 7—6 net.

Glycogen is that substance in the animal body which corresponds very closely with the starch of plants and its appearance in the cells of different tissues during development. The book is illustrated by five well-executed colored plates. Chapter I is an Historical Introduction; II treats of Methods and Material—viz., Microscopic Method, method of using iodine, preservation of sections, color of the iodide of animal starch, and reaction with methyl violet. The remaining eleven chapters treat of glycogen as found in various parts of the animal body...

THE MICROSCOPICAL JOURNAL.

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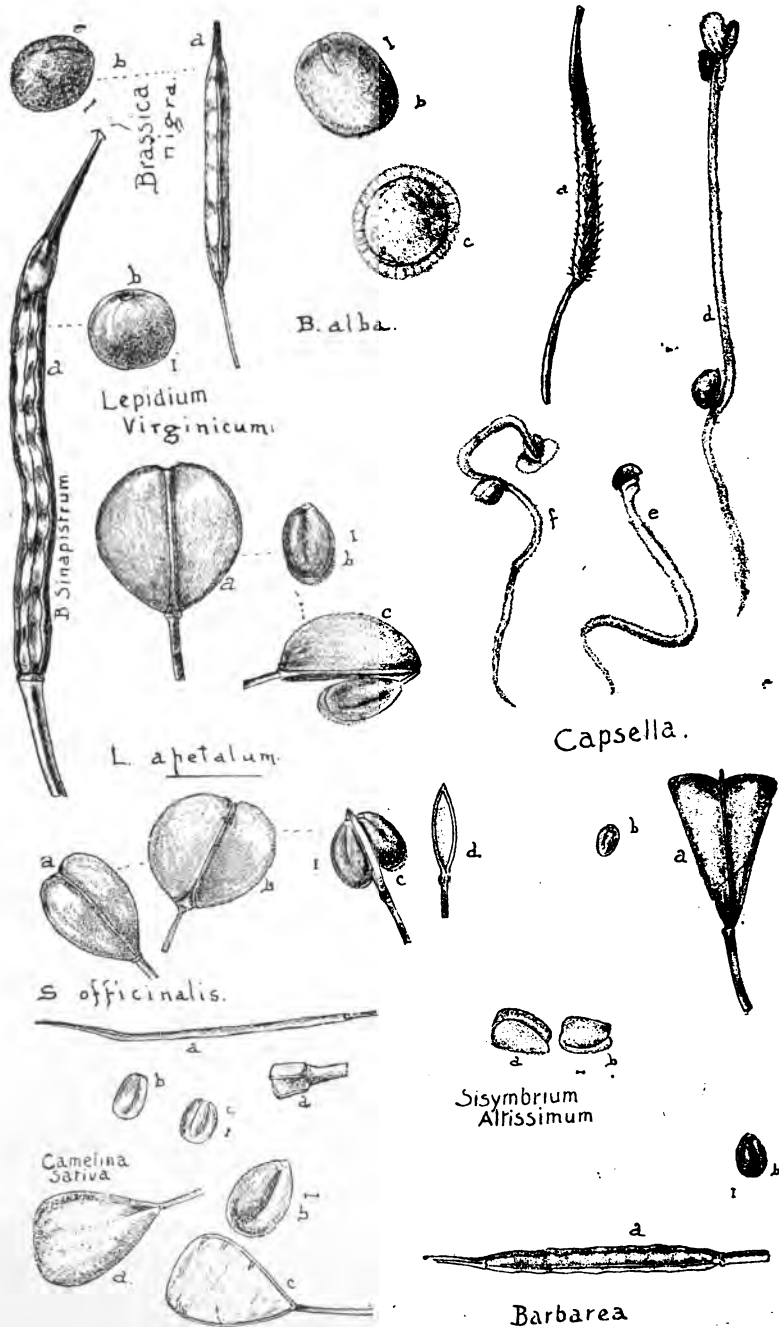
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SEEDS AND TESTA.

THE AMERICAN
MONTHLY
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VOL. XVIII.

JULY, 1897.

No. 7

On the Seeds and Testa of Some Cruciferæ.

BY L. H. PAMMEL,

AMES, IOWA.

WITH FRONTISPIECE.

[Contributions, No. 6, Botanical Department, Iowa Agricultural College.]

It has been known for a long time that cruciferous seeds, when placed in water, become mucilaginous. Grew, the early anatomist, was acquainted with the mucilaginous character of some cruciferous seeds,—*Camelina*, *Turritis*, and *Lepidium*, as well as the plaintain and *Ocimum bassilicum*. In this paper Grew refers to the use of seeds to collect foreign matter in the eye.*

De Candolle, in an early paper on *Brassica*, calls attention to the mucilaginous character of the seeds of the genus. The descriptions given by systematists are brief. The microscopic details are not noted. The following more recent writers have studied cruciferous seeds :—Caspary, Hofmeister, Sempolowski, Abraham, Schroeder, Henkel, Heraud, Schimper, Moeller, Harz, Hanau-sek, Strandmark, Wiesner, Flueckiger and Hanbury, Flueckiger and Tschirch, Tschirch, Tschirch and Oesterle, Klencke, Hoehnel, Kiaerskou, Strasburger, Sachs, Hager, Nobbe, Vogl, Berg, Oudemans, Garcke, Luerssen, Royle and Headland, Tietschert, Kratzman, Schenk, Behrens, Frank, J. D'Arbaumont, Van Tiegham, Godfrin, Zim-

**Anatomie des plantes*. Qui contient une description exacte de leurs parties et de leurs usages et qui fait voir comment elles se forment et comment elles croissent. French Translation, second edition, Paris, 1679, p. 199.

merman, Bonnier, Hicks, and others. Some careful studies were made by Frank, Sempolwski, Hoehnel, Schroeder, Harz, Abraham, and D'Arbaumont.

During the past winter I had occasion to study several of our cruciferous weeds and in that connection a study of the seeds and testa revealed some interesting points, so that it has seemed wise to publish the results of this work, though it is not complete with reference to all the species described in Gray's Manual. The seeds are so characteristic that our weedy species are easily distinguished.

The seeds are round, flattened, oval, rough or smooth. These characters can be made out easily in sections. Cotyledons flat, incumbent,—the back of one cotyledon lying against the caulicle, or accumbent with the edges of the cotyledons towards the caulicle, or longitudinally plicate and partially enveloping the caulicle or conduplicate in cross section (Mustard) or spirally coiled in some cases. A section magnified shows that the testa consists of two well-defined layers and sometimes of a third, which is much compressed. The cell-walls of the outer portion are mucilaginous; those of the second thick-walled. The aleurone layer which various authors have considered as belonging to the testa is endosperm. Strasburger speaks* of the seed as being exalbuminous, and most systematic botanists so speak of it in this way. In the sense that this term was used by early systematic botanists this is correct. Humphrey has called attention to the aleurone layer of seeds and the use of the term. Endosperm of this character is found in the seed of many Leguminosæ where it cannot be made out with the naked eye. We have not thus far found it wanting in the order Leguminosæ. This layer corresponds to that found in

*Handbook of Practical Bot., English translation, Hillhouse, p. 339.

seeds of grasses and, as in that order and in Leguminosæ, the cells are filled with aleurone.

In Cruciferæ several rows of thick and poorly defined cells follow the aleurone layer, being especially marked between the caulicle and cotyledons. The cells of the embryo are quite uniform in size. Distributed through the cotyledons and caulicle occur the procambial vessels and the myrosin bodies in which myrosin is formed. This, according to Spatzier, is for protection and to break up the glucosides.

USE OF MUCILAGE.

The first and most obvious use of mucilage in cruciferous seeds is for the purpose of dissemination, especially in all smaller seeds. This can easily be seen in seeds like those of *Lepidium* and *Capsella*. And secondly for the retention of water on the surface, but this is of minor importance.

BRASSICA.

The anatomical structure of the seed of the genus *Brassica* has been studied by numerous investigators. We may mention the following: Oudemans, Tschirch, Harz, Flueckiger and Hanbury, Hoehnel, Hicks and others.

BRASSICA NIGRA, KOCH.

Pods smooth, one half to three fourths inch long, four cornered, erect, attached to a short pedicel and tipped with a short beak about one eighth of an inch long, about nine seeded. Seeds are black or reddish brown, occasionally grayish when more or less moistened; minutely reticulated. The seeds of this species are much smaller than in *B. Sinapistrum*—three fourths of a line in diameter.

The cuticle covers the epidermal cells as a continuous layer; when mounted in alcohol the outer layer is very much compressed and shows very slight stratification;

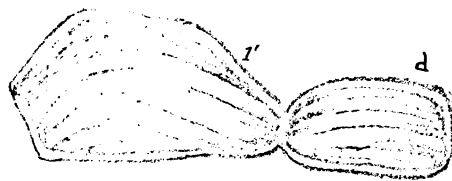
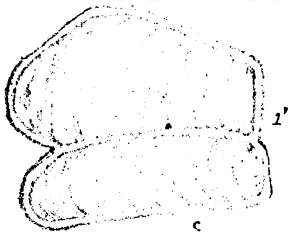
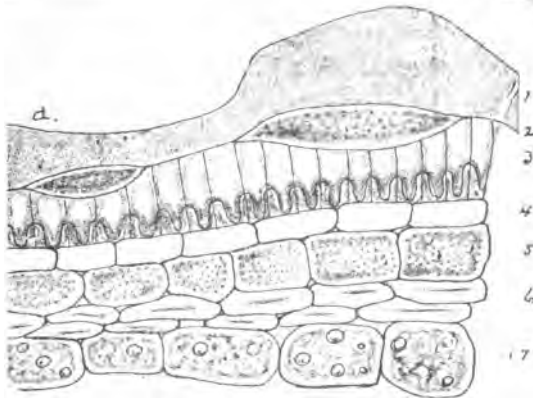
the cell walls expand and after it has been moist for a considerable time the cuticle breaks. Stratification is very evident on the addition of water. The second layer consists of rather thin walled parenchyma. The cells of this layer differ greatly with reference to their size, being scarcely at all developed in places, in others nearly as large as the cells of the outer layer.

The third layer consists of thick walled parenchyma cells, densely packed, radially elongated, thick walled, sides present a cone-shaped appearance. Underneath this is a layer of thick-walled parenchyma cells which contain some coloring matter. The endosperm follows this layer. The first layer consists of thick walled cells, densely packed with albuminous matter. The remaining cells vary in number, much elongated, thick walled with a small cavity; these cells extend down between the contiguous portions of the cotyledon or caulicle.

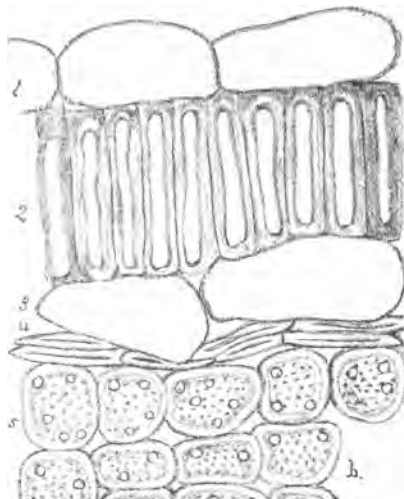
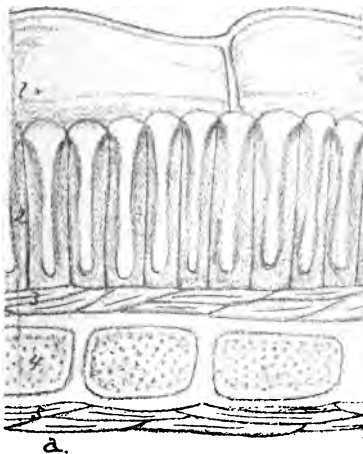
The Embryo:—The cells of the first layer surrounding the cotyledon or caulicle are smaller, filled with fat and protein grains. The remaining cells are larger also filled with fat and protein grains. The central part of the caulicle shows a differentiation of the embryonic vascular portion, consisting of small cells.

BRASSICA SINAPISTRUM, BOISS.

Pods one to two inches long, the seed-bearing portion somewhat torose and nerved, ascending, erect or sometimes appressed, tapering, prominently three to thirteen seeded, and tipped with the globular stigma, the upper one third to three fourths of an inch forming the beak, often with a seed. Seed globular, one line in diameter, brownish black, reticulated, the areas larger than in *B. nigra*, grayish when the seeds have been moistened, darker than *B. nigra*. When examined under the microscope with alcohol, the outer layer of cells is compressed, tabular, stratification not evident, cuticle well developed and forms a continuous layer over the outer cells; on the



B sinapistrum



addition of water, the cell walls become mucilaginous, elongate, stratification becomes evident, the cuticle breaks and an irregular surface is formed. The second layer is but slightly developed, made up of thin walled parenchyma cells. The cells of third layer are elongated and thickened laterally. These cells are much longer than in *B. nigra* and brown in color. The fourth layer consists of one to two rows of rather thin walled cells carrying pigment. Endosperm consists of several rows of cells; first row nearly isodiametric, filled with protein grains. The three or four layers of cells following are thick walled with a small cell-cavity.

Embryo.—First layer of cells nearly isodiametric, those following somewhat larger, filled with protein and fat grains.

BRASSICA ALBA, BOISS.

Pod very bristly, spreading. Seeds pale yellow, round or somewhat oblong, one to one and a half lines in diameter, average a little over a line. Cotyledons incumbent, folded around the caulicle.

The seeds of this species have been studied by many investigators. Parts of the seed are much stronger developed than in *B. nigra*. The first layer of cells is covered by the well developed cuticle. On the addition of water a copious mucilage is developed, the cell wall becomes strongly stratified. A portion of cell wall surrounding the cell cavity is more yellow and has a stratification of its own. When water has been allowed to act for some time, the cuticle breaks, thus causing an irregular margin. Cells of the second layer are somewhat irregular, thin walled, with a large cell cavity and small intercellular spaces; as a rule composed of a single layer of cells but in some places two well developed layers. The third layer consists of cells with lateral thickened walls, which contain a yellow pigment. Cells in the fourth layer are also thick walled.

(To be Continued.)

The American Postal Microscopical Club.**Operations in 1896 and 1897.****By R. H. WARD, M. D.,****TEOY, N. Y.****[From Report of Management.]**

THE MEMBERSHIP remains at about the average number of the last few years. Most of the Circuits are full and in good working order. There are, however, a few scattering vacancies where new members could be accommodated to advantage.

Since the last report the Club has lost by death several of the oldest and most faithful members:—T. B. Redding, Issac N. Himes, Geo. A. Rex, and J. C. House.

SLIDES AND NOTES—During a part of the season now closing, the supply of boxes reached the low-tide mark, necessitating the use of an exceptionally large proportion of the older and sometimes inferior boxes. Recent additions have restored an average supply, of more than average quality. Among the recent notable additions, the Club is indebted for gifts of fine special boxes from Professors Thos. D. Biscoe, Amos P. Brown, and Harry M. Kelly, Dr. D. B. Ward, and Mr. F. S. Morton; and for extra slides from Doctors W. H. Sylvester, and D. P. Frame, Professor N. H. Conser and Mr. Thos. J. Bray.

Besides the ordinary notes, which have often been carefully prepared and valuable, and which it is hoped will receive increasing attention from our members, a large number of special notes, giving a thorough study or demonstration of important subjects pertaining to various new slides have been, and are being, prepared by a few of the more experienced members—especially Vice-President Vorce, Secretary Shanks and the President.

NOTE BOOKS—To deface them with careless scribbling or to mar them in any way, as by stamping, folding,

unnecessary soiling, etc., is an imposition on the members and readers for months and years afterwards. A member lately entered this valuable suggestion: "What a pity to write such an interesting paper with such miserable ink. Let the Club adopt a rule that each member shall type-write his paper, or shall use good ink and the vertical handwriting." While, unfortunately, not all the members can write the "vertical" hand, which is far the best for the notes, any more than all can be required to buy a typewriter, whose work is still more legible, it is not too much to ask for good ink, and, it should be added the careful use of a good medium-fine pen that will give work which is legible and compact. The only ink really fit for use in the notes is the "waterproof drawing ink," bottles of which can be bought for twenty-five cents from the dealers in drawing instruments and supplies, which flows freely and evenly, gives a very distinct line, and, being indelible, will bear handling without smutting, and will therefore wear better than typewriter work or the best of common writing inks. The best-written notes by a very few of our members, are nearly as legible as typewriter printing, and far more compact and durable. Being of a very different consistency from ordinary inks, it should be thoroughly experimented with, using stiff fine pointed pens and not too much ink (thinned if necessary according to accompanying directions), until fine, uniformly good work can be done, before putting it to practical use. Higgins' "American India Ink, waterproof (white label)," is generally used by architects and engineers.

CO-OPERATION—It is a most suggestive fact that expressions of gratification are often made by able and cultivated people in regard to objects so common-place that a thoughtless person might be tempted to pass them by, unseen, with the superficial and flippant criticism that there was "nothing new in the box." This is worthy

of note as a reminder to the expert that many objects which are so familiar to him that he never thinks of offering them to the Club, are capable, with proper explanation, of being valuable to equally learned persons in different fields.

An object is named, not fully described by the label; and the most unpromising object may be valuable by reason of some peculiarity of structure, history or relations that can only be known by a careful view of the slide in connection with its note. Again, the most common slide may have a valuable note; some of the best notes ever in our books have been written to the most insignificant slides, and there are members who could make valuable any slide that could be found. If both slide and note be found weak, what better satisfaction can a member get than to make it useful to his neighbors by his own suggestions?

CIRCULATION—Owing in great degree to the energy and devotion of our Secretary, Dr. S. G. Shanks, and the kind co-operation of the membership generally, the circulation has been, amidst almost unsurmountable difficulties, kept up to a fairly good average. During the season now closing, nearly every circuit will have received thirteen or fourteen boxes, and with as much regularity as possible under the circumstances.

Ovum in Testis of a Lamprey.

By R. H. WARD, M. D.,

TROY, N. Y.

[Abstract of remarks at the Microscopical Section of the Troy Scientific Association.]

This slide of *Petromyzon* is a good anatomical study, showing the essential male organ, the testis, in a riotously active state, producing clouds of spermatozoa; and also showing the characteristic ovum of the vertebrate ani-

mals, which is normally, though not here, the product of the essential female organ, the ovary. But the anomalous origin of this particular ovum makes it one of the most interesting specimens that could be seen under the microscope. It also possesses, along with the interest of a rarity and anomaly, the far greater philosophical interest which always pertains to the beginning of things. This production of one single microscopic ovum by an elaborate gland that naturally, and here, but for this exception, is devoted to a different and incompatible performance, is a simple, uncomplicated first step in a line of evolution, the first link in one of those "nature's chains," about which we hear so much irrelevant and unreasonable talk. It is the first unit toward the growth of an ovarian body, or rather it is itself an absolutely simple ovarian body, combined with a testis, and the first beginning of the development of a perfect ovary in the place of one of the testes. This is equally true whether we regard the transition from testis to ovary to be an advance to a higher or a degeneration to a lower type. The latter, however, is probably true, since the testis is not only further removed in structure from the primitive and simple types of growth, but is more artificial and elaborate in its function. Evidently the ovum and not the testis represents the multiplication of primitive organisms by subdivision before male organs were evolved and male functions established to render possible higher grades of progeny.

In the vegetable kingdom such anomalies as that on this slide often occur, and the transition is in the same direction as here, from male to female and not the reverse. Thus in the Indian corn, certain portions of one or more of the staminate spikes that constitute the tuft at the top of the stem sometimes produce ovaries instead of stamens, and ultimately present well-developed kernels of corn. Likewise among the willows it is the

staminate plant (tree) which reverts, abnormally producing stamens that have an ovary in combination, or that assume the pistil form altogether. Such stamens-ovaries were circulated, by the present writer, in the club boxes many years ago.

It is an interesting question whether in the case of our slide the element of nutrition can possibly be the determining agency, the food-supply in this particular lobule or sack being greater or less than usual, as the case may be, or otherwise better suited to the making of ova than of spermatozoa, and thus causing this strange growth. It will be noticed that the mother cells of spermatogenesis which in all the rest of this testis have abundantly performed their work and filled the cavities and canals with spermatozoa, and have themselves almost entirely disappeared, have in the lobule occupied by the ovum apparently suffered an arrest of development, and remain in the lobule which is otherwise comparatively empty of male products. Was the nourishment just here unsuited to them, or was it so appropriated by the ovum that enough was not left for them?

The scarcity of spermatozoa in the immediate neighborhood of this particular ovum seems to render its fertilization improbable; and the apparently exhausted stock of food-supply in its lobule, and the absence of congested blood vessels prepared to supply the rapidly increasing demand of a developing ovum, seems to imply that this ovule would have shriveled and disappeared from the field of activity of this organ. But an imperfect or partial development of an ovum might conceivably take place sometimes without fertilization, and might easily go far enough to demoralize an organ so little adapted to ovulation as the testis is. On the other hand, if by some extraordinary chance spermatozoa should be developed within access of such an ovum and fertilize it, why should not a (truly) "extra-uterine" pregnancy be established in the

male, which would equal in its character and consequences any of the miraculous freaks of nature that have ever been recorded or dreamed of ! It is fortunate for the males of all kinds and degrees that such consequences are infinitely improbable, and that such development, if commenced, could not probably advance to any great extent, owing to lack of suitable arrangements for nutrition.

It is evident that this case is not an example of hermaphroditism, in its full sense of possessing in an effective form the organs of both sexes, and being able to perform by turns or simultaneously the functions of both ; though this seems to have been the theory accepted by the ancients who coined this word to designate it, and who left many carefully elaborated representations in their art as to what they meant by it. They knew little or nothing of the anatomical difficulties and absurdities which it implied, any more than they, without knowledge of internal anatomy and physiology, realized the similar absurdities of their schemes, likewise founded on external form alone, of mermaids, centaurs, and the like. But it is an hermaphroditism, in its first inception and simplest conceivable form, in the more modern and reasonable sense of a commingling, more or less, of the structures peculiar to both sexes; and it is, again, a first step towards a complete and effective hermaphroditism, if that be possible.

The animal kingdom seems to have got, in the course of evolution, mostly beyond the primitive grade of hermaphroditism, which is still a prevalent policy in vegetation, where we find it generally but not universally present. Its very type is the presence of ovaries capable of reproduction, and stamens capable of fertilization, both on the same individual ; and we find this throughout the range of complex individuality in the most familiar plants. In the single flower we find both fertilized and fertiliz-

ing organs commonly though not always present; and the same words might be said of the flower-cluster or "inflorescence," and of the whole "plant," whether it be the tiny herb or the greatest tree. In some of the lowest forms, where each plant is but a single cell, and where the simplest conceivable form, perhaps, of sexual reproduction takes place by one of the plants merging itself into and thereby fertilizing another (conjugation), the cells are similar under the microscope, and unless there is some difference of structure as yet unknown, it may be assumed that each one is hermaphroditic in its powers, being able to fertilize or be fertilized as the chance may occur. So in the slightly higher grade of filamentous algæ, where the cells are united in a line, not apparently for interchange of food or products; but for securing advantage of position by serving as stalk to each other, and to that important extent constituting a true organism, the functions of fertilization seem to be completely mixed. When the filaments are crowded during the season of fertilization, their various cells fertilize their neighbors or are fertilized by them, apparently at random; and unless there is a sexual difference of structure still invisible and unknown, these cells also must have hermaphroditic powers.

Microscopical Methods of Examination of Powdered Drugs and their Adulterants.

BY ALBERT SCHNEIDER, M. D.,

MINNEAPOLIS, MINN.

Recent applications of the microscope have opened a new field of work to the practicing pharmacist. Unfortunately, only a few of the colleges of pharmacy yet realize the importance of the microscopical study of powdered drugs. But in this age no one is worthy to be considered a leading pharmacist who is ignorant of it. It is now

possible for every druggist to determine whether or not he is dispensing unadulterated remedies. To detect adulterations should be regarded as a part of his duty.

The plea has been advanced that only a few can become sufficiently expert to do such work and that most men lack the required time. Now no advanced treatise upon pharmacognosy is necessary for the prosecution of this study. A pharmacist of average ability can in a comparatively short time become sufficiently familiar with vegetable histology and microscopical methods to do such work thoroughly. The one who advances such a plea as lack of time and of opportunity has surely no moral right to dispense medicines.

The more expert work must be left to investigators of high scientific training, and to those who possess the most desirable apparatus. But what is required for the work here proposed is only ordinary intelligence and average training, combined with application and a desire to be a credit to the profession. After a few months of self instruction, aided by the necessary apparatus and a reliable guide to vegetable histology and micro-chemistry any one can acquire a fair degree of proficiency.

The following suggestions as to equipment, methods and re-agents are especially intended for the benefit of those pharmacists who know practically nothing about micro-pharmacognosy.

Keep constantly in mind not to purchase a single piece of apparatus until it is actually needed. Only such apparatus and accessories as are required by the beginner in the study of powdered drugs, will be recommended herein. In getting an instrument the novice had best take the advice of some impartial and experienced microscopist.

In this country, the Bausch & Lomb Optical Co., of Rochester, N. Y., and Zentmeyer, of Philadelphia, Pa., are the leading manufacturers of microscopes and micro-

scopical supplies. In Europe, Watson, of London, Leitz of Wetzlar, and Zeiss of Jena stand about equal as to their merits but the Zeiss instruments are higher priced.

The Leitz instrument, best adapted for the use of the pharmacist is the new stand IIC., with the following accessories: eye-pieces II and IV, objectives 3 and 7, double nose-piece, Abbe condenser and iris diaphragm. It is fitted with a graduated draw-tube, plane and concave mirror, and adjustable substage. The price of a good instrument with accessories is about \$60.00.

Another indispensable accessory is an eye-piece micrometer, to be used in making measurements of tissues and tissue elements. This consists of a circular piece of glass set in a hard rubber ring. On it is a scale of 5 mm. ruled into 100 parts.

The following are more or less indispensable: 1. A good sharp razor for making hand sections. 2. A stage micrometer. This consists of a glass slide on which is a scale of 1 mm., ruled into 100 parts. This is required to determine the scale of measurement for the eye-piece micrometer. After the scale is determined no further use is had for this micrometer so one might be hired or borrowed. 3. A half dozen or more watch crystals. 4. Glass slides, with ground edges, and cover glasses. Two or three dozen of each will be enough for most purposes.

Other appliances, such as dissecting needles, section-lifters, pincers, compressors, etc., are convenient but not absolutely necessary.

For the mechanism, care and use of the microscope, see these details given in text-books, of which the following are recommended: 1. Rusby & Jelliffe's *Essentials of Vegetable Pharmacognosy*. 2. E. S. Bastin, *Laboratory Exercises in Botany*.

Part two of both these books treats of microscopical methods and vegetable histology; part one, of the gross

anatomy of plants. The book first named is better adapted to the needs of pharmacists. The Bausch & Lomb Optical Co. issue a small book on the mechanism, use and care of the microscope. V. A. Poulsen's *Botanical Micro-Chemistry*, translated by W. Trelease, is an excellent little work on micro-chemical reaction and chemical substances found in plants.

A considerable number of re-agents will be needed whose use will be indicated as occasion demands. Drug-gists will probably have most of them on hand. Staining, imbedding, and preparing permanent mounts, few pharmacists will care to know anything about.

Hæmoglobin and Its Derivatives.

By A. J. BIGNEY,

MOORE'S HILL, INDIANA.

On subjecting a dilute solution of arterial blood to spectroscopic examination, certain parts of the spectrum of natural or artificial light will be absorbed.

The amount of this depends upon the degree of concentration of the blood; if a one per cent or two per cent solution be used, two narrow dark bands are seen in the orange-yellow between the Fraunhofer lines D and E, the one next to E being a wider, but not so deep a band as the one next to D. A little of the red is absorbed and the violet indigo, and a part of the blue. This is the spectrum of Oxy-Hæmoglobin.

If arterial blood or venous blood which has been shaken with air be treated with some reducing agent such as ammonium sulphide or alkaline iron sulphate with tartaric acid, a decided change occurs in the spectrum. Instead of two bands only one appears, which is between the two lines of Oxy-Hæmoglobin, and is much broader than either of the bands mentioned above. This is the spectrum of reduced Oxy-Hæmoglobin or simply Hæmoglobin.

METHÆMOGLOBIN.

The spectrum of Methæmoglobin is obtained by first preparing Oxy-Hæmoglobin crystals by treating dog's blood with ether and shaking it until it becomes laky, then allowing it to stand in a cool place for an hour or so, at which time a firm mass will be formed, due to the crystals. The mother liquid is separated from the crystals by filtering through muslin or linen, squeezing the mass so as to obtain the crystals in as pure a form as possible. The crystals are dissolved in distilled water and a dilute solution is examined with the spectroscope. The two bands of Oxy-Hæmoglobin appear. A few drops of potassium permanganate are added and the solution gently warmed. If sufficient time has elapsed for the oxidation of the Oxy Hæmoglobin, the two bands will have disappeared and instead a single band in the red near the line C between C and D. Nearly the entire spectrum is absorbed. Sometimes it is a little difficult to get this band, but if the oxidation has taken place it will be seen. In the experiment at hand I left the solution until the next day, before it would give the above result.

CARBON-MONOXIDE HÆMOGLOBIN.

If coal gas be passed through blood which has been defibrinated, it will assume a cherry-red color, the carbon-monoxide of the gas having driven off the oxygen of the Oxy-Hæmoglobin and taken its place. The reducing agents have no influence upon this new substance, it being more stable than Oxy-Hæmoglobin. The two absorption bands are nearer to E than in the Oxy-Hæmoglobin spectrum.

HÆMATIN.

The red corpuscles are composed of a proteid stroma and a brownish pigment which is called hæmatin. The iron is a part of the hæmatin. It can be obtained either as the acid hæmatin or the alkaline hæmatin.

In making the acid hæmatin, I took 100 cc. of 95 per cent alcohol and added 2cc. of sulphuric acid, and then 10 cc. of blood; the mixture was boiled for about an hour in a flask tube three or four feet long so that the vapor passing off would be condensed in upper part of the tube and flow back into the flask.

During this process a precipitate is formed which is acid hæmatin. The solution is filtered and the precipitate is dissolved in alcohol and then examined. Since the precipitate is soluble in alcohol, that which is obtained by filtering does not represent all the hæmatin, for a part would be dissolved while boiling. The spectrum has one broad band near C. Most of the remaining portion of the spectrum is also absorbed.

If 95 per cent alcohol be added to blood and a small quantity of caustic soda, a still different spectrum is obtained. This is the alkaline hæmatin spectrum. It is similar to the acid hæmatin except the dark band is near and often on D.

Announcement of the Toledo Meeting of The American Microscopical Society.

BY E. W. CLAYPOLE,

AKRON, OHIO.

The annual meeting will be held at Toledo, on August 5, 6, and 7. The Microscopical Society of that city have taken up the matter very cordially and intend to do their best to make the visit and the meeting both pleasant and profitable.

The members outside of Toledo are asked to do their part to secure the success of the meeting by their presence if practicable, or, if not, by sending contributions to be read. Short notes on methods of work, notices of observations, details of experiments are all of value and will be welcome.

There is an interesting field for the existence and activity of this society in this country and the recent advance of microscopical investigation all along the line has enlarged its scope for the worker. There is abundant material waiting to be worked over which can supply endless subjects for discussion. The demand for microscopical knowledge and proficiency in the medical practitioner at the present day is so great that few among the older members of the profession can keep pace with the requirements and one of the best methods of keeping in touch with the advance of the medical art on the part of the younger men is the maintenance of a connection with such a society. They can thereby become acquainted with methods, men, and learn from time to time in what direction and by whom their field of labor is being enlarged.

To the teacher, too, membership is invaluable. The peripatetic nature of the society which holds its meetings in different places year by year brings them within the reach of different sections of the country and so reduces to some the cost of attendance. Any one, man or woman, engaged in any line of teaching which involves the use of the microscope can pick up hints enough from those whom he, or she, will meet to repay a moderate expenditure. And in the present day a teacher in any such line who is not progressive will soon become a fossil.

Persons desirous of joining the society either as active workers or as learners are requested to send their names to the Secretary, Dr. Wm. C. Krauss, of Buffalo, N. Y., to Mr. Magnus Pflaum, of Pittsburgh, Pa., or to the President, Dr. E. W. Claypole, Akron, Ohio.

The subscription is two dollars yearly with an entrance fee of three dollars, in return for which a member is entitled to a copy of the proceedings containing the papers read at the annual meetings.

Analysis of the Raised Coast Period Clay.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

The analysis of the raised coast period clay was made by Prof. B. Silliman and published by Prof. J. W. Bailey in a paper entitled: "Notice of some new localities of Infusoria, recent and fossil" (Amer. Jour. Sci. and Arts, 1844, Vol. XLVII, page 337). He examined the clay, blue clay, from New Haven, perhaps the same as the Quinipiac marshes, in which W. A. Terry has described the Diatoms. Being used as a fertilizer, an analysis was made. When magnified it is found to contain particles of quartz, hornblende and feldspar derived from the rock granite of the Green Mountains which were brought down when it was formed, in the glacial period. There were seen the following diatoms:

Actinocyclus senarius.

Coscinodiscus excentricus.

" *oculus-iridis.*

Cocconeis oceanica.

Dicladia ?

Eunotia westermanni.

Galionella (Melosira) sulcata.

Grammatophora oceanica.

Pinnularia perigrina.

" *lyra.*

" *didyma.*

These are all Naviculas now, for I quote Bailey's original list.

Raphoneis rhombus.

Tesselo catena.

Dictyocha specutum.

" *fibula.*

Spongioliars caput-sepertensis.

The analysis was :

Silica.....	58,633
Alumina.....	30,563
Oxide of Iron.....	6,186
Carbonate of Lime.....	4,263
Magnesia.....	0,705
	100,350

So it is an aluminium and iron silicate. When we compare the analysis of this clay with other Infusorial clay, as at Richmond, Va., Monterey, Cal., etc., and with the diatom ooze of the Atlantic and Pacific oceans, they are found to be essentially the same. I should style it a good mineralogical species and should be disposed to name it Collonite, not crystalline of course but formed from the water, marine or peat, from which it was thrown down.

Microscope Slides of Vegetable Material for Use in Determinative Work.

BY JOHN S. WRIGHT,
INDIANAPOLIS, IND.

In the determination of plants it is frequently necessary, or at least desirable, to make examinations of various organs with the aid of a lens. Seed markings, glandular structures and many portions of the flower upon which determinations are partly based may be so minute as to necessitate slight magnification for satisfactory work. For example we have in the *Euphorbias* and *Lobelias*, many species in which the seeds are to the naked eye mere granules, but under a hand lens, their surfaces are seen to be decidedly marked with irregular ridges and pits, or are handsomely sculptured. Many leaves contain glandular structures or are covered with hairs or scales which can be best seen under the lens. In determining specimens on which such structures exist and are of value in classification, it is often desirable to compare them with like material from well determined herbarium specimens. Commonly the material for these

comparisons is dug out of or cut off the herbarium specimen as it is needed from time to time and placed loosely under the lens for examination, and after it has served the purpose of the moment is brushed aside and lost or at best preserved in packets upon the sheet with the specimen from which it was taken. This method is mussy and eventually impairs the mounted specimens of an herbarium, and where there are many workers it is not economical of time. To avoid this is quite practicable through the preservation of all such materials dry in cells upon glass slips as opaque mounts for the microscope. The cells are built by gluing to the glass slips brass rings, and the specimens are enclosed by cementing to the top of this ring the ordinary circular cover glass. The method of building this form of cell was suggested by Dr. Griffiths some years ago and is quite familiar. A cell of this form will not accommodate leaves and some other plant structure as well as another form of cell, which is made by gluing a rectangular frame cut from cardboard to the glass slip. A cell of this construction will contain small leaves entire or the tip and basal portions of the larger leaves, which can be viewed from either side. A cell of this type must be enclosed by a rectangular cover-glass. A supply of slips upon which cells of various sizes have been built, may easily be kept on hand, and whenever it becomes necessary to remove from an herbarium specimen material for examination, it may be placed in a cell in manner best adapted for its display, labeled, and you have at once, at very small expense, a slide of vegetable material which will be ready for use at any future time; and, if such a collection of slides is properly classified and arranged, it forms a working adjunct to the herbarium of much value, and, besides, provides one constantly with available material for numbers of demonstrations in botanical work.

EDITORIAL.

Postal Club Notes.—We are indebted for many of the items in this issue to the report of the Club which is printed and circulated privately among its members. We could save the Club expense and gratify our subscribers by printing its entire report for it once a year or better two or three times per year.

John C. House, of Troy, N. Y., who died January 22, 1897, was a man of gentle and refined nature, quiet habits and agreeable manners, of good heart, good sense and good will, a gentleman of the old sort, whose presence was ever a pleasure and an aid to his friends. May we see more of his like, again! He was a business man of professional instincts, whose leisure time was largely spent, with evident pleasure, in microscopical and astronomical study. He was for ten years secretary of the Troy Scientific Association, his last public act being the attendance at the last annual meeting of the Association, and taking rough minutes of the meeting which was to have commenced his eleventh year of service, but which his sudden death prevented his writing out. He was a member of the Club for eleven years, and most of the time in charge of one of the home-circuits in Troy; and notwithstanding the feebleness of advanced age, he was was one of the most careful, trustworthy and efficient members. In the note book of the last box that reached him, the date of its receipt was carefully entered in his handwriting, though he lived not long enough to reach the three days' time at which he should, and would, have forwarded it.

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MICROSCOPICAL APPARATUS.

An Oblique Light Illuminator.—When using light for illumination, oblique to the axis of the microscope, it is found that about 150 degrees is the best angle to put it at. Less than that does not bring out the fine markings on the *Pleurosigma angulata*, for instance, and more than that, is more than the objective can stand so that the color results.

But a simple and efficient oblique light illumination is desirable. It is made in the following manner : A piece of glass rod such as is used by chemists for stirring solutions, $\frac{1}{4}$ inch long and about $\frac{1}{8}$ inch thick is taken and the round side ground down on a whetstone so that the ground part is rather fine. This can be accomplished by using a whetstone with a fine grain. The rod is ground down about one-third—about two-thirds are left. We have then a lens with parallel sides. It is cemented, the ground side uppermost by means of a solution of Gum Thus in alcohol and colored blue to a glass slide. The blue is imparted to it by means of a blue dye such as is sold by chemists and is an aniline dye. It is used downwards, the object glass to be viewed is placed above it and wet between them by means of Oil of Cassia. This allows the light to pass through and at the same time alters the refractive angle so that an oblique ray can enter. At the same time the light is colored blue, a color that is pleasant to the eye and at the same time objects seen in it can be seen with distinctness owing to the peculiar color. The light is a kerosine lamp and the mirror is a concave one placed at an angle of 150 degrees to axis of the microscope. I find this illumination is very practical and brings out the markings on fine lined objects or "beaded diatoms" nicely. It is easy to make. If tried by some reader will he let the results be reported?—A. M. Edwards, M. D.

MICROSCOPICAL MANIPULATION.

Bacillus of Diphtheria.—In examination of stained bacteria, use all the illumination you can obtain. Sunlight is best. Use Abbe condenser without a diaphragm, or with the largest opening of an iris diaphragm. A 1-12 oil immersion is necessary to clearly distinguish.

No objective yet made will bear this treatment and give critical image.

Gummy Media.—I once made some very satisfactory mounts of Algae, etc., in peach tree gum dissolved, or,

more properly, softened in acetic acid. I think there is a fine field for experiment, for anyone who has the time in devising an aqueous gummy medium, applicable especially to unstained vegetable mounts. C. M. VORCE.

Molasses as an ingredient of the Cell was formerly used to prevent cracking; but it proved a mistake which caused the loss of many fine slides, as in all cases black spots appeared sooner or later.

The best cell I know of for balsam mounts is made of Le Page's glue and some insoluble water color. They dry in an hour or two after being made, and will hold forever.

D. B. WARD.

Are the very small black particles that form these spots evolved from the chemical constituents of the molasses, or are they from the bone-black filters used in its manufacture? LePage's glue is probably glue or gelatin dissolved in a strong solution of borax, and, if covered externally with a good water-proof finish, it would seem to be permanent.

S. G. S.

BACTERIOLOGY.

Fossil Bacteria.—M. B. Renault has long worked at the identification of bacteria found in geological strata, and now publishes the general results of his observations in a paper illustrated with a large number of drawings. As might be expected from their simple structure, bacteria appear to have been coeval with the first appearance of organic life on the earth, the coccoid form being apparently earlier than the bacillar. Indications of their presence are found in bone, teeth, scales, and coprolites, as well as abundantly in vegetable tissues. Spores and sporanges of ferns appear to have been especially subject to their attacks. The species are, as a rule, distinct from those at present in existence.—Ann. des Sciences Naturelles.

Bacterial Diseases of Plants.—Dr. V. Peglion describes in *Malpighia* a disease which attacks the stem of the hemp, causing disintegration of the tissues. It appears to

be produced by an organism of the nature of a bacillus embedded in mucilage, and very closely resembling *B. cuboniana*, a parasite of the mulberry. In Bulletin, No. 12, for 1896, of the Division of Vegetable Physiology of the U. S. Department of Agriculture, Mr. E. F. Smith states that several species of Solanaceæ—the potato, tomato, and egg-plant, *Solanum melongena*,—are attacked by a disease which he calls “brown rot,” due to a hitherto undescribed parasite, which he names *Bacillus solanacearum*. It closely resembles *B. tracheiphilus* and the form known as “Kramer’s bacillus,” but differs in several characters from both. In the *Revue Mycologique* for 1896 M. E. Roze has described several bacteria which cause diseases in the cultivated potato, viz., *Micrococcus nuclei*, *imperatoris*, *pellucidus*, *albidus*, and *flavidus*. He says that *M. pellucidus* is always found associated with the “scab.”

BIOLOGICAL NOTES.

Size of Stained Blood-Corpuscles.—My experience has been that human blood, or any non-nucleated blood, appears best when unstained. It may be an optical illusion, but I cannot escape the conclusion that staining reduces, in some manner, the size of the corpuscles.

When stained on the slide by the process of Dr. Moore, as these corpuscles were, there is no change of size produced by the staining. The coagulable matter of the blood and of the corpuscles becomes fixed, so to speak, by the drying process, and while permeable to aqueous fluids does not swell up, nor does it, on the subsequent drying, contract beyond its original dimensions when first dried. I have tested this by many measurements, and while there is sometimes a minute variance in the measurements, it is no greater than ordinarily occurs in successive measurements of the same corpuscle, stained or unstained. Dr. Moore tested this by measuring dry corpuscles, then staining them and remeasuring the same corpuscles which were identified by their relation to certain marks on the slide. I have slides of blood, spread at a single sweep and

stained on one half of the smear, leaving the other half unstained, in which measurements of a given number of corpuscles, taken as they come, from each part, give identical results.

C. M. VORCE.

Crystals in Blood Corpuscles of Frog.—I have a slide prepared by the process of the late lamented Allen Y. Moore, M. D. The blood was spread on slide, and dried; flowed with aqueous sol. of eosin, and washed; flowed with aqueous sol. of methyl blue, and washed, dried, and mounted in balsam.

The blood of fishes, frogs, and perhaps other reptiles, often exhibits crystals apparently within the corpuscles when simply dried without staining. This has been noticed by many observers.

These elliptically formed crystals are not in the same plane as the corpuscles, and seem to be on the cover-glass. It is the custom of some to cleanse the covers in an acid solution, and then rinse in alcohol. If this was done, the cause of the crystals being there might be from an insufficient washing after the acid bath. If a few drops of a saturated solution of any of the salts in water be dropped into a little alcohol, the salt immediately crystallizes into individual crystals such as are seen in this mount. I have had slides showing crystallization in film so thin as to be seen only by polarized light, which I attributed to an insufficient washing after soaking in a cleansing bath of borax solution; and I believe that if they had been rinsed in alcohol it would have produced individual crystals and not a thin film.

THOS. J. BRAY.

Larvae of Clothes Moth.—These larvae are very small at first; the body is white and soft, and seems to need the protection of the tube or case which it builds from the woolen fibres cut small and cemented together. My specimens were taken from a fancy worsted crocheted mat, of no earthly use, and consequently somewhat neglected; the dyed wool as utilized by the insect makes a pleasing object. The six anterior feet of the larvae are strong and can drag the caterpillar and its case along in this fashion: the body

is thrust out ahead, and the case is dragged up to it and adheres by its roughness until the body can be again thrust forward about half its length, when the case is again "hitched" forward. The masticated wool may be seen in the intestine; the pieces are liberal in size, which seems to indicate a very robust digestible tract. A mass of stored up fat may be seen at the posterior extremity of the body. This worm is able to make muscle, fat, blood and moisture out of the dry wool fibres. S. G. S.

Bog Moss Leaves.—The bog mosses are widely distributed in cooler climates, being the chief source of peat and turf deposits. They keep moist for very long periods, preserving the water in the bogs when the surrounding country is completely dried up. The cells of the leaf are of two kinds: (1) narrow elongated cells filled with chlorophyll, the so-called ducts, and (2) large empty cells stiffened by spiral or annular thickenings, and perforated by large pores which communicate with the exterior. These large cells are called the utricles; they retain the water for a great length of time, and serve as homes for various worms, rotifers, amoebæ, etc., some of which may be seen in a slide. A. P. BROWN.

Statoblasts ("winter eggs") of Pectinatella.—These are not eggs, since they cannot be traced to a single cell. A statoblast is formed by the separation of a mass of cells within the tissue of the Bryozoan; this mass cannot be traced back to any one cell, hence it is not an egg, or a developing egg, but is to be regarded morphologically as a bud, an internal one to be sure, which surrounds itself with a thick double cellular coating, and passes the winter in this shape. The statement in most text-books that the statoblasts are parthenogenetic eggs has been absolutely disproved. If at the time when they are beginning to form, transverse sections be made, of the colony, these cell masses may be clearly made out in the funiculus, and the stages in their formation may be followed.

HENRY B. WARD.

The Water Mites (Hydrachnidae).—These aquatic

members of the order Acarina are easily secured and preserved either alive as aquarium objects which will prove very interesting with their brilliant colors, odd forms and lively dispositions, or preserved with a corrosive sublimate solution, or in a mixture of glycerine, 2 parts, absolute alcohol 1 part, 2 per cent acetic acid (glacial) 2 parts, and distilled water 3 parts.

The writer will gladly give any aid in this study to those requesting it, either through identifications, or hints about collecting and studying the group. He will also deem it a great favor if any observer who secures the specimens but does not care for them will forward them to his address; or, if desired, he will collect in other groups in exchange for water-mites. ROBT. H. WOLCOTT, Lincoln, Neb.

DIATOMS.

Diatoms from Redondo Beach.—The bed upon the Pacific coast, 18 miles south-west from Los Angeles, Cal., from which this deposit was obtained, occurs at points from Redondo northward to Monterey and possibly farther. It has not always been found as rich as this waif, nor as the deposit in situ at Redondo.

This bed may be considered the counterpart of the great fossil diatom bed buried beneath the Atlantic coastal plain from New Jersey southward. The geological age of the Atlantic bed is now well known to be Miocene. The age of the Pacific coastal bed the writer has not as yet been able satisfactorily to ascertain, but it is probably either Miocene or Pliocene. The Atlantic coastal diatom bed dips very slightly and regularly toward and under the ocean; the Pacific coastal bed has been disturbed and upheaved from its original position, and sometimes dips quite steeply and nearly vertically, though generally also toward the ocean it borders.

LEWIS WOOLMAN.

Distribution of Diatoms.—Diatoms are found in both marine and fresh waters, the specific forms being mainly different in each. Both marine and fresh water diatoms occur in the fossil state. They frequently form a consid-

erable component part of beds of great thickness in past ages. Beneath the Atlantic coastal plain there has been continuously traced a marine Miocene bed from Asbury Park, N. J., to Richmond and Petersburg, Va. It outcrops along the deeply-cut creek banks about Richmond, and underlies the town. It occurs between the depths of 16 and 95 feet at Asbury Park, between the depths of 400 and 700 feet at Atlantic City, N. J., and between the depth of 400 and 800 feet at Crisfield, Md. Its maximum thickness, so far as yet known, is therefore 300 to 400 feet. At Richmond, however, it is but about 25 feet thick.

A fresh water deposit, of Pliocene age, underlies the Llano Estacado or Staked Plains of Texas, an area several times larger than Pennsylvania. LEWIS WOOLMAN.

MICROSCOPICAL NOTES.

Crystals from Muller's Fluid.—As an object for the study of embryology, this slide [of fetal tissues hardened in Muller's fluid, and mounted through clove oil into benzole-balsam] is good; but look at it with your polariscope and tell the rest of us what these beautiful crystals are, which stud the entire surface of the mount. They evidently do not belong to the fetal hand, for they are diffused throughout the mounting fluid. If the preparer, after hardening in Muller's fluid, omitted to wash out the bichromate of potash from his object, these needles are bichromate of potash crystals. They have a somewhat rhombic form, which is what would be expected.

H. M. F.

Sonorous Sand from Hawaii.—The present writer has recently received from Dr. Benj. Sharp, who, with Prof. Libbey, visited the Sandwich Islands during the summer and fall of 1893, some of this same sonorous sand. It was obtained from a dune facing the beach upon the island of Kauai. Geologically the island is the oldest of the group, having been first formed; it is the only one of the islands on which dunes occur. All of the islands are of volcanic origin.

This sand is mainly composed of minute worn fragments of molusks. In that received by the writer there occur a considerable number of foraminifera, some quite perfect but most of them much worn. On treating the sand to hydrochloric acid, so as to dissolve the calcareous material, about 1-25 of the original bulk remained. This remainder is evidently chiefly composed of small, worn, sand grains, derived from the volcanic rocks of the island; it contains a few, very few, marine diatoms.

Sands which emit sound when their particles are rubbed together, as when trod upon, are not infrequent, and are not confined to calcareous sands. The writer has noticed them in the siliceous sands on the beach between one and two miles south of Beach Haven, N. J. None of these sands emit sounds when wet; to do so they must always be dry. They are locally called by various names, as sonorous, sounding, barking, musical, and æolian sands. Alexis A. Julien has written an elaborate paper upon "Musical Sands."

LEWIS WOOLMAN.

Section of Chalcedony.—Silica, Si O_2 , occurs in nature mainly in two forms, (1) crystalline and anhydrous as quartz, and (2) amorphous and hydrous as opal. Chalcedony is generally described as a crypto-crystalline variety of quartz; that is to say, while it is essentially crystalline in structure, the individual crystals in the mass are too small to be distinguishable. It is usually found forming crusts and lining cavities or cracks in rock, and is a secondary mineral formed by the deposition of silica in successive layers, this taking place so rapidly that there is no opportunity for the formation of distinct crystals of quartz. No doubt in many cases the silica thus deposited is largely gelatinous when first precipitated, but a crystallization soon takes place, so that in the mineral as usually found there is not very much opal in proportion to the crystallized portion. The crystallization proceeds from centre in a radial manner, so that the surface takes an irregularly rounded form which is described as botryoidal or mamillary. Between these minute crystals there is generally

more or less opal or uncrystallized silica which contains water, so that analysis shows that chalcedony contains from 0.3 to 2.5 per cent or more of water.

In this section, when examined in polarized light, the needle-like radiating crystals of the quartz are seen to form circular areas, in which the successive layers of growth can be well seen. These areas represent in section the rounded elevations of the free surface. Each circular area is composed of a very great number of crystals, which give it the radial character. These areas interfere with each other more or less, but an examination of their concentric banding as seen with the polariscope enables one to trace out the different stages of the formation of the mineral. At the edges representing original free surfaces some well-formed crystals of quartz have developed and encrust the edge of the section. The same region shows the enclosure of foreign matter, giving a banded appearance in ordinary light. This is essentially the structure of agate, which is simply banded (and generally colored) chalcedony. Carnelian or sard is likewise a variety of chalcedony of a red or yellow color (not banded).

AMOS P. BROWN.

NEW PUBLICATIONS.

Biological lectures delivered at the Marine Laboratory at Wood's Holl. Ginn & Co., pp. 188; constitutes a very interesting volume.

Microscopic Internal Flaws inducing Fracture in Steel. By Thomas Andrews, F. R. S., F. C. S., M. Inst. C. E., etc. 8vo, pp. 52. (London : E. and F. N. Spon. 1896.)

A paper of considerable importance to Civil Engineers, reprinted from *Engineering*, on Microscopic Internal Flaws in Steel, Railway Locomotive and Straight Axles, Tyres, Rails, Steamship Propeller Shafts, and Propeller Crane Shafts, and other Shafts, Bridge Girder Plates, Ship Plates, and other Engineering Constructions of Steel. There are 30 micro. figures showing internal defects.

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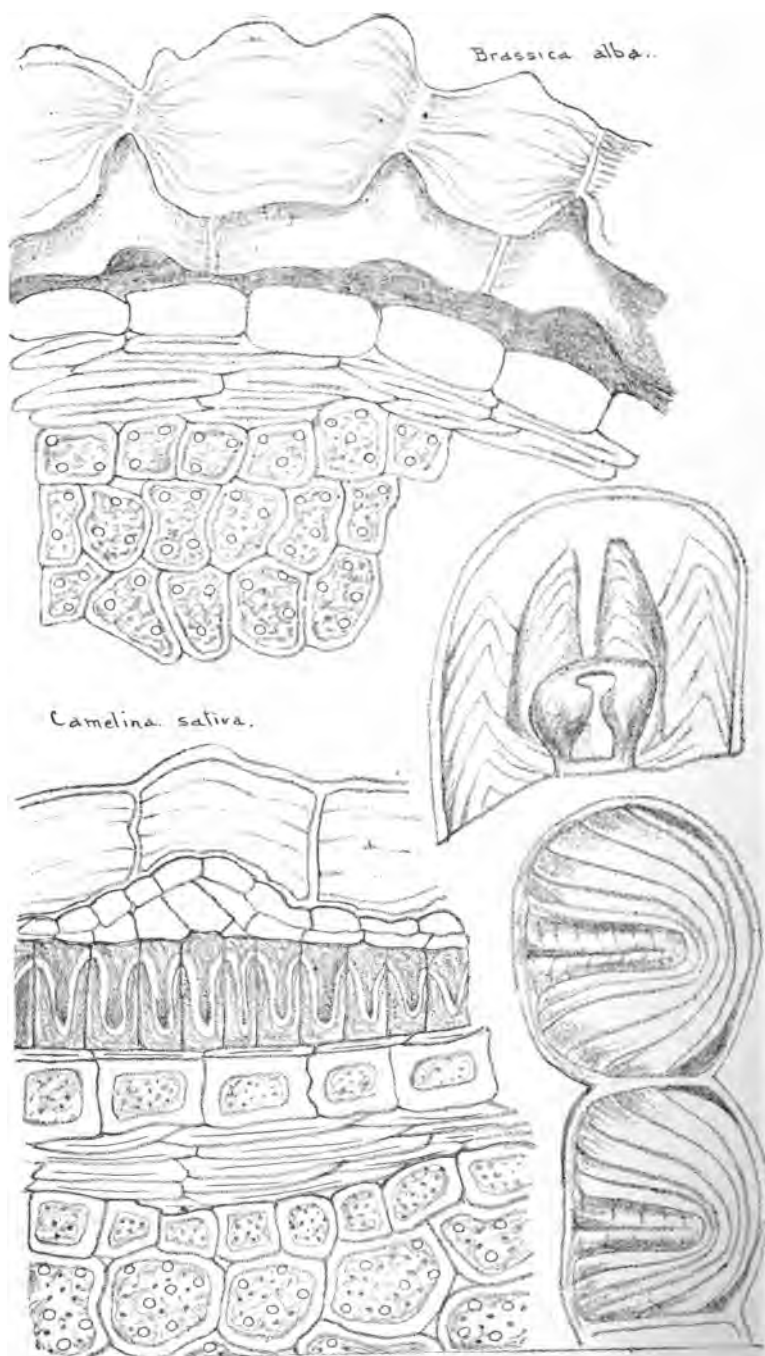
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SEEDS AND TESTA.

THE AMERICAN

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OCTOBER, 1897.

No. 10.

Public Water Supply for Small Towns.

By M. A. VEEDER, M. D.,

LYONS, N. Y.

Drinking water that is manifestly bad does not make everyone who uses it sick. Even when the mains and reservoirs of a public water-system have been infected by such a poison as that of typhoid it is only exceptionally and for limited periods that as many as one per cent of those using the water contract the disease. An outbreak of 2,000 cases in a population of 200,000 is ordinarily regarded as a severe epidemic, and yet this is at the rate of only one person in a hundred. It is this immunity on the part of the great mass of the people that permits infected systems of water-supply to continue in operation. If there were no resisting power on the part of the individual, all would die on the slightest exposure and the source of danger would be thoroughly identified and avoided. As it is, however, for every one that contracts the disease there may be as many as a hundred who escape. Thus it becomes a question of probabilities, and there is a chance for much plausible theorising and controversy. Gradually, however, as the result of increasing observation and experience, crude ideas that have prevailed are being eliminated and the truth of the matter established.

Only a few years ago the most essential point in the improvement of water-supply was thought to be the

determination of the chemical ingredients held in suspension or solution. Elaborate systems of analysis were devised for this purpose, and the quality of the water was judged almost entirely by its chemical reactions. Thus it becomes customary to consider the questions involved from a chemical point of view exclusively. The simple dilution of contained matters of a chemical nature if carried far enough, would make them harmless. Consequently large bodies of water were supposed to have a power of self-purification in direct proportion to their size. In like manner precipitation, sedimentation, aeration and other chemical and mechanical processes were supposed to have a purifying effect. The quantity of sewage entering a stream being known, it becomes possible to tell with a good degree of certainty at what distance mingled with such a volume of water, it will become so diluted, diffused and changed as to be unrecognisable by any chemical test. The dose of poisonous matter, if of a chemical nature, ought to be divided and sub-divided to such an extent as to be entirely harmless in the quantity of water that any individual would consume. In practice, however, this is not found to be the fact, sewage infection being capable of producing epidemic disease for many miles along a stream entirely out of proportion to any possible chemical process of diffusion.

The whole tendency of modern research has been to show that the question as to the spread of disease through the agency of water is biological rather than chemical. It is the presence of certain living organisms and of the conditions on which their continued existence depends that leads to the spread of disease. A single seed may be the means of overspreading an entire continent with some form of luxuriant growth, and so a single disease germ may start an epidemic, not through any mechanical or chemical process of division or subdivision, but because having life it grows and multiplies.

The danger consists not in the quantity of such organisms but in their power of growth under given conditions. If capable of living in water, they may infect an entire stream instead of disappearing by processes of dilution within a few rods. Unlike chemical poisons, they have no fixed poisonous dose. The smallest possible inoculation may prove fatal through the power of self-propagation which they possess. If, on the other hand, their growth be hindered by unfavorable temperature, moisture or food supply, they may become harmless no matter what their quantity. It is true that they have chemical effects, originating substances known as toxines, some of which are deadly poisons, but they themselves depend upon possession of life for the modes of activity which they exhibit. Throughout it is a question of vitality under particular surroundings.

Typhoid fever, cholera and certain forms of dysentery are the chief diseases whose infection it is generally admitted can live in water. In addition, about ten years ago, the writer came to the conclusion that the term malaria, signifying bad air, is a misnomer, and that diseases of this class are very largely, if not exclusively, conveyed in water. Towns taking their public water-supply from ponds or streams having distinctly malarial surroundings have become subject to such fevers although previously free from them.

The manner of spreading of the diseases which have been named originates two classes of dangers. If water be taken from the vicinity of human habitations there is liability to contamination from excreta washed into the pond or stream used as a source of supply, or, in the case of wells, the strong action of powerful pumps may originate a rapid flow underground extending many hundreds of feet and carrying impurities through coarse gravel or open crevices in the soil. That this is the fact appears from the manner in which ordinary wells at a considera-

ble distance from the pumping station run dry when the latter is in operation. Such contamination from human sources may originate typhoid and diarrheal disorders. If, on the other hand, the source of supply is remote from human habitation there may be malarial contamination. Indeed the natural habitat of malaria is in new and undrained countries and virgin soil. In view of this distribution of the disease it is surprising that well-drained cities, having perfect sewers, should yield a certain percentage of malarial fevers until the source of their water-supply is noted, it being in such cases, as a rule, some pond or stream in whose vicinity these diseases are prevalent. Shallow wells in alluvial soil also may yield malarial infection. It is said that since the substitution of deeper artesian borings for such wells there has been a notable decrease of malarial diseases in some parts of the Southern States of North America.

In many localities it is difficult, if not impossible, to secure an adequate supply of water free from the forms of contamination to which reference has been made. This necessitates some system of purification.

It has been discovered recently that there is an antagonism between disease germs and what are known as nitrifying organisms, which produce nitrates and nitrites in the soil. Advantage has been taken of this to institute an intermittent process of filtration. Water containing the bacteria that it is desired to destroy is allowed to run into a filter composed of sand, containing an abundance of nitrifying organisms, and instead of being drawn off immediately is allowed to stand for a sufficient length of time to permit the destruction of the disease germs by their natural foes.

Such filtration as that just described is but the perfecting of natural processes. Alternation of rainfall and dry weather operates substantially on the same plan, tending to purify the ground water in the soil from infec-

tion and making wells possible. Thus in localities where artificial filter beds are impracticable it may be possible to resort to wells with similar results. Experimental borings are required in order to determine whether the quantity of water is adequate and whether the soil through which it percolates is adapted to secure its purification. This being done and the system established, the intermittent action of the pumps, running a part of each day like intermittent filtration, yields a much purer supply than could be had in any other way. A point to be guarded against is the influx of surface water, which is specially liable to contain malarial infection as well as other impurities. To this end, numerous small wells, consisting of iron pipes put down to the proper depth and having perforations over a space of six or eight feet from their lower extremities, covered with fine wire gauze, may be employed. Another plan that may serve is to have a single large well, twenty feet or more in diameter. A convenient method of construction of such a well is by the use of a curb, built up in a hexagonal or octagonal form, of plank laid flatwise and spiked one upon the other in layers. If such a curb be made, slightly smaller towards the top, it can be carried down successfully through almost any sort of soil and stoned up.

It has been thought best to enter somewhat into such details as have been indicated, because they illustrate the principles involved in improvement of water supply, especial reference having been had throughout to localities whose resources are limited. The adaptation of laboratory results to practical uses is the point specially sought to be accomplished in this brief summary. The sanitary engineer, the practising physician and the skilled microscopist are upon common ground in these studies.

At the present stage of progress it must be admitted however, that serious imperfections are unavoidable in the

best systems of water-supply available in many localities. This being the case, household methods of purification require to be taken into the account. That preferred by the writer is as follows: The water is boiled and allowed to stand in a covered stone jar until all sediment has deposited. It is then transferred to ordinary air-tight glass fruit jars, a lot of which, having convenient modes of fastening, are kept for the purpose. When put in an ice chest or cool cellar such water comes out beautifully clear, sparkling and palatable. Such water has no unpleasant flavor unless kept too long, and even this might be avoided by sterilising the jars and filling them with the water while hot, which would require reheating after the sediment is removed. Practically there is no necessity for this extra trouble. Certainly all the waters treated by the writer in this way have proved to be excellent, and there can be no question as to their freedom from the infection of any of the diseases that have been named in the discussion. It may be noted also that substantially the same principle is employed when water is used for quenching thirst in the form of tea, coffee, soups and the like. It is the boiling that makes such waters safe, the various ingredients added serving to please an acquired taste for the most part. Mankind is accustomed to take many precautions of this sort without any clear ideas of the reasons. It is the province of advancing civilization to enable such precautions to be taken intelligently, and consequently more perfectly, and this is the aim of the present discussion in regard to water-supply.—Proc. A. M. S.

Exchange.—H. W. Parritt, 8 Whitehall Park, N. London, England, wishes to exchange microscopical slides, books and objects for crustaceans, echinoderms, sponges, zoophytes, shells and other marine objects, fresh or dried.

The Brain of the Embryo Soft-Shell Turtle.

SUSANNA PHELPS GAGE, PH. B.,

ITHACA, N. Y.

In a paper read before the Microscopical Society last year, upon the "Comparative Morphology of the Brain of the Soft-shelled Turtle (*Amyda mutica*) and the English Sparrow (*Passer domesticus**)," certain questions were raised, which could only be answered by studying the development in the soft-shelled turtle, as : When and how do the characteristic features of the brain in this group of turtles arise? When and how do those features arise which distinguish them from birds?

Professor Eigenmann, who was present, kindly sent me six embryos of *Aspidinectes*, a closely allied genus of the turtle, in different stages of development. Serial sections were made of the heads and mesal views reconstructed. A brief summary of the result obtained is given below. Fuller statement, with illustration, is reserved until more material is studied.

The body of the youngest specimen was 7 mm. long; the form generalized; the face short; the diameter of the eye, one-half the length of the head. A narrow carapace was distinguishable in a specimen, with length of body 11 mm. In the oldest specimen the carapace was 16x11 mm., and had the characteristic leathery appearance and markings of the adult. The snout had also the elongated form of the adult. The feet were webbed. The diameter of the eye, though twice as great as in the youngest specimen, was only one-third the length of the head.

1. As seen from the meson, the most striking difference between the early and late forms of the brain is the general shape. Taking as reference points the

*TRANSACTIONS American Microscopical Society, Vol. XVII., 1895, pp. 185-238, 5 plates.

center of the geminum, the union of the myel with the oblongata and the tip of the olfactory lobe, in the youngest embryo, the figure formed is an isoceles triangle, in the succeeding stages changing to a flattened triangle by the elongation of the base. The cephalic limb of the triangle increases greatly, while the folding of the caudal part of the brain produces an actual shortening of the caudal limb of the triangle. In the adult *Amyda* the flattening of the triangle has proceeded to an extreme. The change of form in the brain is apparently greater between the time when the external appearance of the adult is established, as in the oldest embryo, and the true adult condition, than between the oldest and youngest of the above described embryos. This is due to the fact that after the external adult appearance is complete the cerebrum and the cerebellum both acquire their largest comparative growth.

2. At the constriction occurring in the brain-tube, between the postcommissure and the floor of the cranial flexure, the brain shows the least increase in size, as shown by different measurements upon the meson of the embryo and adult brain. This stationary condition is probably due to the early maturing of the region.

3. The union of the olfactory lobes across the meson was not found in these turtles until the beginning of the carapace was distinguishable, and did not present the comparative extent and close connection of the adult until the oldest embryo had the adult appearance. That is, as was found with the sparrow, the union across the meson is of late occurrence and secondary importance.

4. Those parts of the cerebrum, apparently connected with olfaction, the hippocampal, progress with equal step with the olfactory lobe, and not until the oldest embryo is the fimbrial edge of the hippocamp and its union across the meson, the fornicommissure, well established. The late appearance of this commissure is con-

sonant with great variation in different types, but this study tends to corroborate the opinion now gaining ground, that this commissure in the lower vertebrates is not a callosum.

5. That part of the cerebrum so prominent in the adult, the caudatum, or elevated portion of the striatum, is only found as a rather inconspicuous object in the oldest embryo, but the precommissure, in which fibers from the upper parts of the striatum cross, arises as the carapace begins to form.

6. In the roof of the brain the postcommissure is a well-formed landmark in the earliest of the embryos, while the commissure, bounding the opening of the epiphysis, the supracommissure, shows as a mere trace in the youngest embryo and attains a disproportionate development in the oldest. A similar culmination in growth is seen in the oldest embryo in the associated epiphysis, habenae and the fiber tract extending from this region to the cerebrum, a fact apparently indicating that in ancestors of this group having comparatively simple brains these parts were of more importance, for in the adult turtle they are overshadowed by the later developing parts.

7. The membranous roof in all embryos is a simple unfolded membrane, clearly continuous with the paraplexuses of the cerebrum. The latter, in the early stages, are simple membranes, which show folds only when the carapace begins to develop, and become quite complex in the oldest embryo. The paraphysis, at the point of union of the diaplexus with the paraplexuses, is a widely open tube in all the stages, and becomes early convoluted.

8. The medicommissure, a feature which is found in mammals and reptiles, but not in birds, arises in this turtle only in the oldest embryo, in this being like mammals, in which it also appears late, and showing that

though characteristic, it is of secondary importance.

9. In the infundibular region of the embryo are seen distinct folds and pits, which are nearly obliterated in the adult. A pair of protuberances, dorsad of the hypophysis, occurs in the younger forms, and is represented in the adult by a single mesal notch. Dorsad of the hypophysis, occurs in the younger forms, and is represented in the adult by a single mesal notch. Dorsad of these a mesal protuberance, lying between two commissures, is much more prominent in the younger specimens before the commissures are formed. The decision upon homologies of these protrusions of the wall with either the albicans of the higher forms or the hypoaria of fishes must be reserved, there are details of difference in both.

10. In the turtle, all parts connected with vision are well developed. In the youngest embryo the optic recess is clearly traceable to the eye along the optic nerve, as the remains of the originally open vesicle. This remnant becomes more convoluted, the endymal cells giving an almost glandular appearance, in the stages when the carapace begins to develop. In the oldest embryo this appearance is gone, but the numerous cells of the chiasma in the adult may represent this convoluted vesicular remnant.

11. The optic geminum does not lose the form of a thin roofed single vesicle until in the oldest embryo a mesal depression occurs, forming the paired geminums, and at the same time an extensive union across the meson by means of the geminal commissure, and a division of the cells into two layers arise. The late formation of this solid roof of the geminums is interesting in connection with the fact that in birds the roof is a membrane.

12. In the latest embryo the cerebellum is only just beginning its growth as a great mesal feature, though considerably earlier it is apparent as a lateral organ. In the youngest embryo its appearance is like that of

the *Amphibia*, having a small mesal portion. With its growth caudad it revolves, so to speak, about a fixed point, carrying the thin membranous wall before it, and thus forms the folded metaplexus of the adult. The oldest embryo shows this admirably.

13. The floor of the oblongata undergoes wonderful changes, from a comparatively thin-walled condition in the youngest embryo, through one in which series of rounded thickenings occur, these in turn becoming united, as the carapace develops, to form the continuous thickened floor of the oldest embryo.

From the above it is seen that partial answers to the questions mentioned are now possible.

(a.) The general form of the brain of the soft-shelled turtle wherein it differs markedly from the other described turtles is only acquired after the embryo has the external appearance of the adult, the great relative growth of the cerebrum and cerebellum taking place after that period. (Sec. 1, 2.)

(b.) The union of the olfactory lobes across the meson and the large caudal growth of the cerebellum seem to be characteristic of this group of turtles, and it was found that both are of late development. (Sec. 3, 12.)

(c.) The broad distinctions between the bird and reptile brain are, that the latter possesses a medicommissure and a solid roof to the geminums; in the soft-shelled turtle both of these features arise in the late embryo.

That is, in the brain not only those features which distinguish the group of turtles, but which most evidently distinguish birds from reptiles, arise in this turtle about the time the external form is characteristic of the genera. The brain, however, lags somewhat behind the body in assuming characteristic features.

Other questions arose as to the appearance of the nidi and their relation to sulci, which cannot yet be answered conclusively.

On the Seeds and Testa of Some Cruciferæ.

By L. H. PAMMEL.

AMES, IOWA.

WITH FRONTISPIECE.

Continued from page 274,

CAMELINA SATIVA, CRANTZ.

Pod obovoid, four to six lines long, smooth, reticulated, margined from beak down along placental side with smaller ribs between them. Seeds light brown, one line long, minutely pitted, caulicle prominent, running lengthwise with a prominent groove between it and the cotyledons. Cotyledons incumbent.*

Seed coats consisting of four layers. The outer epidermal cells not much longer than wide, on the addition of water become mucilaginous and well stratified. On the addition of chloral hydrate stratification more evident. The cell-walls differentiated into several different substances. The second layer not always developed. Cells of third layer with thick walls and brown pigment, followed by a narrow layer of thick walled brown cells. The first row of cells of endosperm, rather thick walled, filled with protein grains, the other layers of unequal development, cells elongated, thickwalled; followed by cells of embryo; these contain protein grains and fat.

EXPLANATION OF THE FIGURES.

I. July text, page 209, (Reprint, page 7). *Brassica nigra*: a, mucilaginous cell before the addition of water; b, after addition of water; 3, brown thick-walled cells; 4, parenchyma cells; 5, aleurone layer; 5-6, endosperm; 7, cells of embryo. B. *sinapistrum*: c, mucilage cells expanded; 4, endosperm in figure to the left, embryo in figure to the right.

II. September frontispiece (Reprint, page 12). *Sisymbrium altissimum*, *S. officinale* and *Capsella bursa-pastoris*: The upper row of cells consists of mucilage cells; the lower row contains embryos; about midway between may be seen the endosperm.

III. September text (Reprint, page 13). *Lepidium virginicum*. 1, mucilage cells; 3, 4, endosperm; 5, cells of embryo; b, mucilage cells when moistened.

IV. October frontispiece (Reprint, page 15). *Brassica alba*: Upper row, mucilage cells; third and fourth rows, endosperm. *Camelina sativa*: upper

*Harz. l. c. p. 924. Fig. 71.

row, mucilage cells; third row, thick-walled cells; fourth row, aleurone cells; lower row, cells of embryo. Figures on right of plate, mucilage cells when moistened.

All the figures were drawn to the same scale.—X320.

A Partial Bibliography on Mustard Seeds.

The writer wishes to express his obligations to Prof. Wm. Trelease of the Missouri Botanical Garden, who allowed free access to the library of the garden for the purpose of completing this list.

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A Cause of Foul Water in Reservoirs.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

To the presence of a bacillarian, a diatom in fact, is due a certain fouling of drinking water. Prof. Leeds, of the Stevens Institute of Technology has given to it the name of *Asterionella flavor*. In the report on the city water of Brooklyn, N. Y. it is detailed. The results arrived at are microscopically and technically of great value.

By order of the board constituting the department of the city works, on September 4, 1896, the Engineer was requested "to make such examination of the Brooklyn water supply as he should deem necessary, in order to determine the cause of the complaints made in regard to its quality, and the remedy to be applied.

Daily examinations showed that immediate action was necessary. The objectionable appearance, taste and odor during the mid-summer periods has been essentially due to the protista, a plant growth known as *Asterionella*.

It has nothing whatsoever to do with artificial causes like drainage, sewage or contamination. It is due to purely natural causes, the first being the microscopical chemical constituents of the water, and the second, and even more important, being the physical conditions in which the water is placed after entering the reservoirs. The important questions to consider are:

I. What is the *Asterionella*, and what is peculiar about it?

II. What is there in the composition of the Brooklyn water, or the mode of handling and storing it, that has fitted it especially for the development of the *Asterionella*?

III. How can growth of this organism be prevented?

I. *Asterionella* derives its name from its form, being a star-shaped organism usually 3- or 4-rayed. It is a diatom, a bacillarian, usually called an alga, although more properly called a protiston. The latter is distinguished from most other algæ by being enclosed or having a skeleton or envelope capsule of silica, or soluble silica hydrate. This particular genus has the further peculiarity of secreting a substance in the nature of an oil which possesses a taste and odor so characteristic that, for lack of a better name, is called *Asterionella* flavor. It is a combination of fishy, salty and oily tastes, its odor resembling that of certain varieties of geranium.

Although some of the samples of the reservoir water contained as many as twenty million individuals to the gallon, yet it would require many hundred gallons of the water to get enough of the oily product which imparts taste and odor, to work upon in the laboratory to accurately determine its nature. In many of its properties it resembles trimethylamine.

In the month of August, when the trouble was at its worst, the water had a white appearance and was filled

with minute white threads. On standing, it threw down a flocculent deposit of a stringy, whitish or yellowish white matter. Under the microscope, this deposit was found to consist of innumerable *Asterionella* matted together with other diatoms strung together in threads the other diatoms, being more especially *Melosira*, *Tabelaria* and *Synedra*. These thread-like forms have not been noticed to produce the objectionable taste and odor secreted by the *Asterionella*, and, moreover, they were vastly less abundant. The water itself was colorless, the apparent color being due to the suspended organisms. The oily taste-producing substance is volatile and cannot be gotten rid of by distillation. It distills over with the steam, giving to the distilled water a faint whitish appearance or opalescence, and communicates to it the same characteristic taste and smell.

Neither can it be got rid of by filtration through paper or cotton or a thin layer of sand. Sand will arrest nearly all the *Asterionella* and then on being washed with pure water, the water used in washing and containing the plant will be found to have taken up the taste and odor. To remove both the *Asterionella* and all the taste and odor arising from it, it is necessary to filter through animal charcoal or thorough a properly constructed sand filter of sufficient depth.

The most characteristic feature of the diatom is its envelope of silica. There are many other kinds of microscopic organisms represented in the different portions of the Brooklyn water supply, such as green algæ, the bluish green algæ and the fungi, Rhizopods, Rotifers, Crustaceans, etc., but none of these are characterized by the presence of silica, and do not in the same sense imperatively demand it as a constituent of their food. Moreover, the number of non-silex-secreting organisms is insignificant when compared with the stupendous number of diatoms. Thus Prof. Leeds says, but he for-

gets that the silica in the loricæ of bacillaria, or diatoms, is in a very soluble form and bacillaria are also present in all water, marine, brackish and fresh, the world over. Silica can also be dissolved when in the crystalline form, as clear, transparent rock crystal. It is very likely that in this manner silica comes into solution and not by the action of alkali, potash or soda, which are also common in all soils. But, he says, "such being the case there must be a great abundance of dissolved silica in the Brooklyn water, and something in the nature of the water-shed which enables it to impart the silica. As a matter of fact, the ponds and streams contributing to the Brooklyn supply have sides and bottoms of sand, which is silica in an undissolved form." But silica is always soluble! "Moreover all the water has an alkaline reaction and is capable, therefore, of dissolving silica and holding it in a soluble form. The wells, indeed, are the chief source of the silex of the Brooklyn water. The complete analysis of the mineral constituents given later shows the wells to contain 1.5 parts per 100,000 of silica. But by dilution with the surface waters containing relatively less, the silica in the combined supply is only about half as much. But even then, it amounts to 9 per cent of the total mineral matter present. This large amount is more than ample for the nutriment of the enormous number of silicious algæ which thrive and multiply in the Brooklyn resevoirs and distributing mains.

Where do these Bacillaria come from? A microscopical examination of the water from several Brooklyn shallow wells, shows a few Bacillaria, the Asterionella, however, being found but once. From one basin however they were plentiful, being 6,400 per cubic centimetre. The sample taken from the centre, but at the bottom of the resevoir, at the same time, contained 11,616 and the efflux 9,552 Asterionella.

Besides the silica, what else in the way of food do the

Bacillaria require? Multiplied observations in many localities have shown that such a stupendous growth as the reservoirs exhibited last summer is possible only when there is present an abundant supply of food in the form of assimilable nitrogen.

Why should this transformation of ammonia, nitrites and nitrates into nitrogen and the immense multiplication of *Asterionella* take place in the reservoir, and not in some pond or stream where *Asterionella* are found, and where abundance of food is likewise present? To explain this it is necessary to have recourse to what is known of the habits of life of the *Asterionella* in cases where its enormous multiplication, along with the accompanying taste and odor have been observed. Its multiplication is essentially favored by abundant access of light; by a gentle, tremulous motion in the water, and by storage in shallow reservoirs. All of these conditions exist in an convenient degree in the Brooklyn reservoirs. Together with the kind and quantity of food they are ample to explain what occurred in an aggravated form last summer, what is observable now, although to a far lesser extent, and what will occur at different seasons in the future until the physical conditions that render the occurrence possible have been removed.

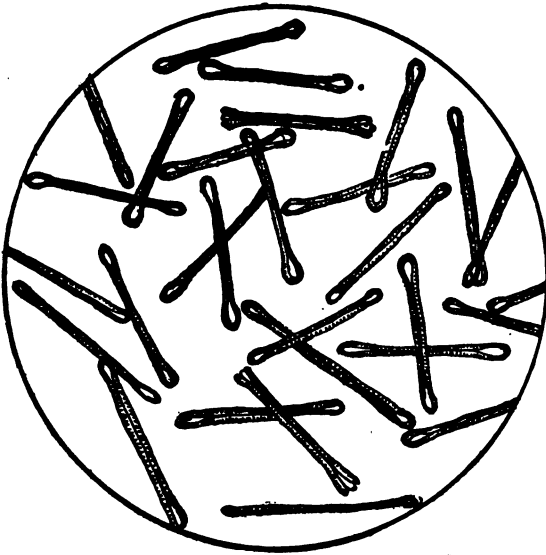
So far as is known the only remedy which has proved effectual has been that of excluding the light, and converting the reservoir into a substantially subterranean basin. The proposal to aerate the water, which was advocated last summer, was fortunately, not entertained. Prof. Leeds speaks with the more positiveness upon the subject inasmuch as he introduced the mechanical aeration of water supplies, and has seen its introduction followed by the happiest results in cases where conditions favorable to stagnation were dominant. But the reverse of such conditions exists in the present instance, and the aeration of the water in the Brooklyn reservoirs

with its accompanying large expense, would result only in intensifying the trouble. Neither will filtration of the waters before they enter the reservoirs answer. In fact he thinks that the *Asterionella* is the chief cause of the trouble. I have taken the above facts from Prof. Leed's report and commend it to the attention of every one interested in pure drinking water.

Prof. Leeds says that the *Asterionella* flavor is from a substance which in many of its properties resembles trimethylamine, and trimethylamine occurs somewhat widely distributed in nature. Thus, for instance, it is found in various plants, as the *Chenopodium vulvaria*, *Annica montana*, *Murcurialis annua*, the bloom of the hawthorn, that of the wild cherry, and of the pear, as well as in ergot, and other fungi parasitic on cereals. It also occurs in various animal liquids, and especially in herring-brine. It is likewise found as a product of decomposition of various alkaloids, and amongst the products of dry distillation of nitrogenous, organic matter and of wood. It has a powerful and penetrating characteristic fish-like smell. I have found it as a characteristic twice of *Asterionella* in the season when ovulation takes place and it seems to be characteristic of the enlargement of the oil globules as they are called, or ova as I designate them.

The reproduction of the *Bacillaria* seems to be this: As the individual is found, it contains, besides endochrome, or olive-colored matter, large oil globules which are transparent and look extremely like drops of oil. These are colorless and permanent so that when the *Bacillarian* individual is dried up the endochrome withers away but the oil globule stays and when the individual is acted upon by acid, the oil globule is not so readily acted upon. These I shall show are ova or female organs, as the individual opens there appear certain minute dots which are extremely active in motion. They increase in

quantity and at one stage occupy a large part of the interior of the frustule, the endochrome withering away or being crowded to the sides. As the breeding season approaches the interior is often dotted by innumerable active little globules and two or sometimes more ova or oil globules. Then in some way the contact of the anthozoa, as I have called these active little globules, and the ova takes place. How, I know not for they are ex-



Asterionella flavor.

tremely minute and the contact is only momentary. But sometime, I think that I shall see how the contact takes place. At this time, or evolution, the characteristic odor, the formation of trimethylamine smelling, takes place. This is the ovulation of *Bacillaria*. It takes place in all forms more or less, but is most rapid in forms which occur in such enormous quantities. This form I have found to be as rapid as any in coming and going. Perhaps it is more so than other *Bacillarian*.

The Microbe of Yellow Fever.

BY GIUSEPPE SANARELLI, M. D.

MONTEVIDEO, URUGUAY.

The best way to demonstrate not only the presence, but also its special tendency to arrange itself in small groups, preferably in the blood capillaries, consists in placing in the incubator, at 37° C. for twelve hours, a fragment of the liver taken from a fresh cadaver in order to favor the multiplication of the specific microbe. The yellow-fever bacillus grows sufficiently well in all the ordinary culture media. In common gelatin it forms rounded colonies, transparent and granular, which during the first three or four days present an aspect analogous to that of leucocytes.

The granulation of the colony becomes more and more pronounced, appearing ordinarily as a nucleus, central or peripheral, completely opaque; in time the whole colony grows entirely opaque. It never liquefies gelatin.

In beef bouillon the bacillus grows quickly, without forming either pellicles or deposits.

On blood serum solidified it grows in a manner almost imperceptible.

Cultures on agar-agar represent for the "bacillus icteroides" a means of diagnosis of the first order; but the demonstration by this means of diagnosis is efficacious only under certain determined conditions.

When the colonies grow in the incubator, they present an appearance that does not differ from that of the majority of the other species of microbes; they are rounded, of a slightly iridescent gray color, transparent, even in surface, and regular in outline.

If, instead of causing the colonies to grow in the incubator at a temperature of 37° C., they are allowed to evolve at a temperature of from 20° – 22° C., they appear like drops of milk, opaque, projecting, and with pearly

reflections; that is to say, they are completely distinct from those grown in the incubator.

These different modes of evolution can be used for diagnosis by exposing cultures, first, for from twelve to sixteen hours to the temperature of the incubator, and afterward for other twelve to sixteen hours to the temperature of the air.

This done, the colonies show themselves to be constructed with a flat central nucleus, transparent and azure, having a peripheral circle prominent and opaque. This peculiarity, which may be considered specific, may be made evident in less than twenty-four hours, serving thus to establish the bacteriological diagnosis of the "bacillus icteroides."

Apart from this morphological characteristic, which suffices of itself to differentiate the microbe of yellow fever from all others previously known, the "bacillus icteroides" is endowed with some interesting biological qualities.

It is a facultative anaerobe, and does not resist the Gram stain; it ferments insensibly lactose, more actively glucose and saccharose, but is unable to coagulate milk; it does not produce indol, and is very resistant to drying; it dies in water at 60° C. or after being exposed for seven hours to the solar rays, and lives for a long time in sea water.

The microbe of yellow fever is pathogenic for the greater number of the domestic animals. Few microbes have a pathological dominion so extended and so varied. Birds are completely refractory, but all the mammiferous animals upon which I have experimented have shown themselves more or less susceptible.

But of all the animals, that which lends itself best to showing the close analogy, anatomically and nosologically, between experimental yellow fever and human yellow fever, is the dog.

The virus should be injected into a vein. The morbid process that results manifests itself almost immediately, with a violence of symptoms and an assemblage of lesions which recall the picture, clinical and anatomical, of human yellow fever.

The lesions found after death are extremely interesting, as they are almost identical with those observed in the human cadaver.

Attention is called before everything to the intense fatty degeneration of the liver. The hepatic cell, examined in a fresh state with a little osmic acid, appears completely turned into fat, as it is in human victims of yellow fever; the yellow-fever toxin, as we shall see later is a true specific poison to the hepatic cell, as are phosphorus and arsenic. A complete fatty degeneration of the liver may be affected by injecting directly into it, through the abdominal parietes, a fresh culture of the specific bacillus.

The kidney shows a severe fatty degeneration, accompanied by lesions of acute parenchymatous nephritis, which may be considered the direct causes of the anuria and the uræmic intoxication.

The digestive apparatus shows lesions of hemorrhagic gastro-enteritis as intense as those caused by poisoning with cyanide of potassium. They are completely analogous to those in man, though more grave.

A bacteriological fact of great interest in the yellow fever of the dog is that in the majority of cases the "bacillus icteroides" is found in the blood and the organs in variable quantity and in a state of absolute purity; at times, it is found associated, as in man, with the coli bacillus and the streptococcus.

As the tendency to secondary microbic infections has been proved even in the yellow fever intoxication of the dog, provoked with a pure culture, filtered, it must be concluded that the yellow fever poison, whether by itself

or whether through the alterations it produces in the different viscera, and especially in the liver—which, as is well known, should be considered the organ of defense against microbes—favors in the dog secondary infections having their point of departure in the intestinal canal.

This is an important point of resemblance between the yellow fever of the dog and that of man.

From the results of the first part of the investigations relative solely to the comparative morphology, biology, and pathology of the “*bacillus icteroides*,” we can deduce some fundamental conclusions concerning the etiology and the pathology of the yellow fever of man.

Yellow fever is, then, an infectious disease, due to an organism well defined and susceptible of being cultivated in the common artificial nutritive media.

The micro-organism, which I have designated provisionally with the name of “*bacillus icteroides*,” can be isolated, not only from the cadaver, but also during the life of the yellow fever patient.

Its isolation presents generally difficulties, sometimes invincible, due in part to the constant presence of secondary infections, and in part to the relative scarcity of the organism in the body.

These secondary infections, due almost always to certain species of microbes, as the coli bacillus, the streptococcus, the staphylococcus, the proteus, etc., may appear in the organism long before the death of the patient, which is often attributable to their action rather than to that of the “*bacillus icteroides*.”—*Med. Record*.

DO YOU WANT GOLD? Everyone wants to keep posted on Yukon, the Klondyke and Alaskan gold fields. Send 10 cents for large Compendium of vast Information and large color map to Hamilton Pub. Co., Indianapolis, Indiana.

EDITORIAL.

Benjamin F. Quinby, of Chicago, died suddenly at Goshen, Ind., July 18, 1897, aged 62 years. He was born in Concord, N. H. and moved to Chicago in 1853, having previously been in a wholesale grocery in Philadelphia. For twenty years past he has been in employ of Fuller, Fuller & Co.

He was active in scientific matters and was one of the oldest members and at one time president of the Illinois State Microscopical society. He was also a member of the Academy of Science of Philadelphia, and that of Chicago, and of the Royal Microscopical society of London. He was well known as an entomologist and his microscopical preparations on insects were known in many other places than Chicago.

Life in Diamonds.—Professor von Schoen, of the faculty of Naples University, and Professor Edward Von Holst of the Chicago University, propose to obliterate the line of demarkation between the organic world and diamonds. They have made photomicrographs, which views, says the Mineral Collector, show the crystal in its birth, the head showing forth from the mother crystal, and the course is followed as it pushes out and away. The crystal meets another one from a different mother. The two strike at each other, they fight, strive and clasp with each other. It is a case of the survival of the fittest. One must die. No two crystals from the same mother ever fight, however, no matter where they meet.

MICROSCOPICAL APPARATUS.

Photo-Micrography.—The following is perhaps the most simple method of doing what is required. Take a smoothly-planed board about 3ft. by 6in. by $\frac{3}{4}$ in., and straight down the center thereof cut a slot about 2ft. long by $\frac{1}{2}$ in. wide, and lastly, affix on the under side, at each extreme end, a fillet about $1\frac{1}{2}$ in. wide by $\frac{3}{4}$ in. thick to strengthen the board and raise it slightly from the sur-

face on which it is to stand, level and firm. As the camera to be used only extends 9in., a box-like extension piece—adding, say, an extra 4in.—should be made and fitted to the front. The camera is secured to one end of the board by means of a usual tripod screw passed from beneath through the long slot, and the microscope is so placed, turned horizontally on its stand, that the eyepiece points centrally through the usual lens *mount* into the camera, the junction between the two being made light-tight by a small velvet sleeve having elastic bands at each end. The ordinary focusing-screen is utterly useless for micrographic work, it being necessary to use a piece of thin patent plate glass, having lines ruled on one side with a diamond. Correct focus is obtained when these lines and the image are seen in focus together through a compound focusser. The condenser and lamp (if the last is used) are, of course, arranged at the other end of the board opposite the microscope and camera.

MICROSCOPICAL MANIPULATION.

Staining Insects' Wings.—Dr. Brodie has given much attention to the setting up and preservation of insects. The following mode of staining the wings of insects which he has devised, will be both useful and interesting. Place the whole insect in a strong alcoholic solution of fuchsin, and allow it to remain there for forty-eight hours. Then transfer the insect to water with a pair of fine forceps, and wash it until no more color comes away, changing the water if necessary. While the washed insect floats in clear water, slip a microscope slide, holding the insect on it with a fine needle, separate the wings from the body with a fine scalpel, and remove the body. Float the wings into position on a drop of clear water, remove excess of water with blotting-paper and allow to dry. Then place a drop of thick Canada-balsam near them and heat over a spirit-lamp. Tilt the slide to allow the liquefied balsam to flow over the wings, lower a cover-glass gently into position and allow to cool. On examination the veins will be found red, the

depth of coloring varying with the length of time of staining, the thickness of the veins, etc.—Science-Gossip.

BACTERIOLOGY.

Anthrax Bacteria in Hides from China.—During the early part of August four deaths occurred among the employes of the Falls Creek tannery near Dubois, Pa., and several cases of severe illness have been reported. Some time ago the tannery company received an invoice of 100,000 hides imported from China. During the process of tanning the liquors drained into the creek. Not long afterwards several head of cattle running at large died. It was discovered that the cattle drank water from the creek. Shortly afterwards several employes were taken sick and in some cases death resulted.

Investigation revealed the fact that the hides were infected with anthrax bacteria. Considerable alarm was caused at Falls Creek over the fatal effects and possible spread of the disease as it proves fatal in from five to eight days, and of the men affected only one has so far recovered.

The matter has been kept as secret as possible, but it is understood that the matter has been reported to the State board of health and an investigation will be instituted.

Pathogenic Organisms and Living Plant Tissues.—Several years ago Dr. H. L. Russel published an interesting paper on "Bacteria in their Relation to Vegetable Tissue" in which it was demonstrated that some of the forms adapted to a saprophytic mode of life may live for considerable periods of time in living plants, but few of the facultative parasites were able to thus live. *Bacillus pyocyaneus* oval schweine senche bacillus did so for some time. These micro-organisms were usually found intracellular. Dr. Karl Kornanter, who has recently investigated this question, makes no reference to this excellent paper. Kornanter worked with pathogenic and saprophytic species. In the case of anthrax bacillus and *Streptococcus pyogenes* the germs did not penetrate the tissues of corn or pea, in

germination the young plants having passed through cultures containing these organisms. Nor were his results with other pathogenic saprophytic organisms more favorable where onions or hyacinth bulbs were used, or when cultures were inoculated into plants above ground. Various minerals speedily destroyed the organisms. It is not probable therefore that pathogenic bacteria are ever taken up by the roots of plants.

Appropriation of Free Atmospheric Nitrogen.—Nitrogradsky is well-known on account of his extended and thorough studies of micro-organisms in connection with the subject of nitrification. He has now given us the result of his studies on the above topic. In isolating these organisms he used what is by him termed the "elective" method of isolation. In this special case a culture medium was employed that was free from all combined nitrogen. It was made up as follows:

Distilled water, 1000cc; 20-40 gr. dextrose; 1 gr. potassium phosphate; 0.5 gr. magnesium sulphate; 0.01-0.02 gr. potassium chlorate, sulphate of iron, sulphate of manganese. This culture medium was then inoculated with garden earth. Most of the cultures soon showed evidence of butyric acid fermentation. Gas bubbles appearing in the immediate vicinity small masses floating in the medium. These masses somewhat resembled Kephir grains. This fermentation continued till all of the sugar was used up. After this fermentation, mould developed on these white grain-like masses, followed by algae. It appears that this medium at first wholly unsuited for higher plants because of the absence of nitrogen was made suitable when appropriation of nitrogen by bacteria had taken place. The Kephir like masses consisted of a species of *Clostridium* to which he has given the name of *C. pasteurianum*, and two kinds of bacteria forming threads. The interesting details cannot be given here. Suffice it to say that this *Clostridium* is capable of obtaining nitrogen from the atmosphere, which is found in the medium in part as soluble inorganic nitrogen, but mostly as insoluble organic

combined nitrogen. (Archives des Sciences biologiques T III. St. Petersburg, 1895, No. Bott. Centralbl. LXV, 277.)

MEDICAL MICROSCOPY.

Diarrhoea in Children and Milk.—It is well-known that milk may give rise to intestinal disorders traced back to the poisonous products produced by micro-organisms. Dr. K. Alt indicates in a paper in *Deutsch. Med. Nochschr.*, 1896, No.5, that all troubles of this kind need not necessarily be referred back to micro-organisms, but in some cases the food consumed by cattle may be responsible for some of this poisoning. In the cases referred to clover was thought to have caused the trouble. All precautions for sterilization seem not to have been taken into consideration. Dr. Alt's conclusions are not warranted.

Tsetse Fly Disease or Nagana in Zululand.—Dr. Bruce claims to have traced the connection of this disease and larger domestic animals to one of the *Flagellatis* (*Trypanosoma evansi*) which is carried over by Tsetse fly. It was shown that the fly was not poisonous, but that when the fly was allowed to take the blood of a diseased dog it could carry the disease to another animal, dog, horse, or bovine. (Centralbl. Bakt. Parasitenk. xix; Abth. I. 955.)

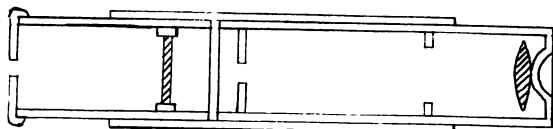
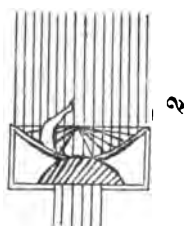
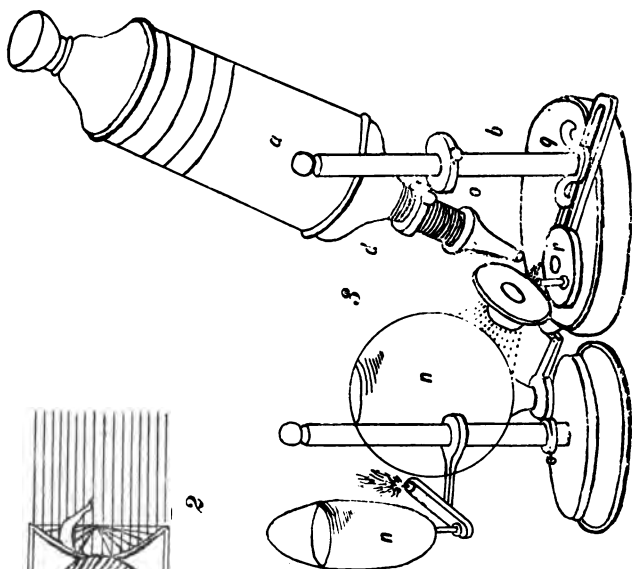
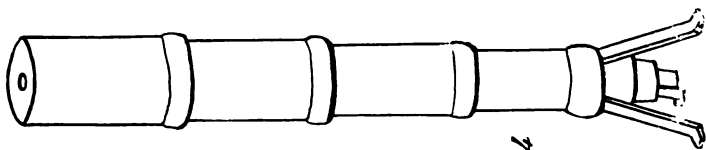
NEW PUBLICATIONS.

Medical Botany.—Moquin-Tandon has published an elementary treatise of 543 pages on this topic which contains numerous figures of medical plants some excellent, others rather poorly executed. The part dealing with phænogams is good but the part dealing with cryptogams is not up with the times, some rather remarkable statements being made. Just two pages are devoted to bacteria *Leptothrix fuccales* and *Merismopidia* (*Sarcina ventriculi*). His information concerning these is somewhat ancient. Reference is made to this part of the work because it is a sample of what one finds too frequently in so called scientific publications.

THE MICROSCOPICAL JOURNAL.

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EVOLUTION OF THE MICROSCOPE.

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No. 11.

On the Evolution of the Microscope.

BY EDWARD M. NELSON,

LONDON.

WITH FRONTISPIECE.

One of the means of guidance for the future is a study of the errors of the past. The end will be best served by (a) a through investigation of a good type of instrument designed at some period subsequent to the introduction of achromatism, tracing the development of its various parts from the earliest times. (b) A study of modern instruments, showing wherein and why they either follow or depart from the selected type. (c) The collation of other material bearing on the development of modern microscopes though not falling within the limits of *a* and *b*.

The first step, then, is the choice of a type. (1) It must be that towards which the modern microscope is tending. (2) It must be a permanent form.

There is only one microscope in which both these necessary conditions are to be found, and that is Powell's No. 1, for it requires the slightest observation to perceive (1) that the best modern microscopes are more and more conforming to that type, and (2) that it has remained in its present form for upwards of twenty years.

Our first duty, then, is to describe all the causes accumulated since the invention of the microscope, that have

influenced the design of Powell's No. 1. We say probably, because it is possible that Powell's No. 1, or any other form of microscope or apparatus, might have been designed by an inventor wholly unacquainted with any preceding form, though in the absence of any evidence to the contrary such a hypothesis would be highly improbable.

Those parts of this paper which treat of old microscopes are not intended to be a history of the microscopes; many interesting old forms will not even be mentioned. For the most part attention will be drawn to only those instruments that have been rungs in the ladder of evolution.

To begin, then, neither the name of the inventor nor the date of the first compound microscope has been with certainty determined. There is an extensive literature on the subject, and the conclusion arrived at is that the first microscope was probably made by Jansen, a spectacle maker, of Middelburg, in Holland, about the year 1660. An old microscope, supposed to be a Jansen, was exhibited at the loan collection of scientific instruments at South Kensington in 1876 (catalogue No. 3,510), the date of it given in the catalogue being 1590. This instrument had neither stand, object-holder, nor stage; the only mechanical movement with which it was furnished was a draw tube for separating the two convex lenses which formed the optical part of the instrument (Fig. 1).

The next step is to be found in a drawing of a simple microscope by Descartes in his "Dioptrique" in 1637. This shows a plano convex lens placed at the vertex of a concave mirror; in short it is an instrument now known as a Lieberkuhn. It is curious to note that while Descartes is very particular about the parabolic curves of his mirrors and the hyperbolic curves of his lenses the figures show the lenses turned the wrong way, which would

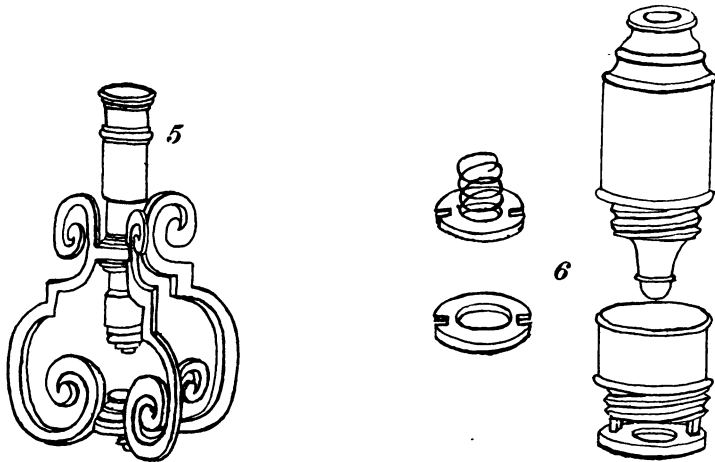
cause the spherical aberration to be increased four-fold. Now as the difference between the aberrations arising from the spherical and hyperbolic curves is for the purposes under consideration insignificant, the above is a remarkable instance of straining out a gnat and swallowing a camel (Fig. 2).

The next important step is the application of a field lens to the eye-piece by Monconys and Hooke. Monconys' microscope was made in 1660, an account of it being published in 1665. The application of a field lens was also claimed by Hooke, who in 1665 published an account of his microscope. Hooke's microscope is a very important one, for in it we find several new features, such as the inclination of the body, a screw focusing adjustment, a movable object-holder, and an entirely novel illuminating apparatus. In Fig. 3 we see a heavy circular foot, *p*, with an upright post, *b*, fixed excentrically to it. The limb which holds the body of the microscope is attached to the post by a sliding ring, *o*, and screw clamp. The limb is also jointed by a ball and socket. At the other end of the limb is a ring, *d*, into which the body screws with a coarse thread. This forms the fine adjustment. The body, *a*, was fitted with four draw tubes. This form of mounting for the body of a microscope I call the "telescope mount," for the microscope is pointed at the object precisely in the same manner as a telescope would be. There is an ingenious object-holder, *r*, consisting of a spike capable of rotation, held by a short pillar attached excentrically to a rotating disc. This disc is held in position by a link and butterfly nut, *q*; obviously, therefore, the object can be placed in any desired position by these combined movements.

The lamp also was attached to a separate upright support by a ring and screw nut, very much in the same way as it is fixed at the present time. There was an engraver's globe, *n*, filled with water for a primary con-

densing bull's eye, and a plano-convex lens, turned in its proper position, *t*, as a secondary condensing lens was fitted to a double-jointed arm. The illuminating apparatus was therefore suitable for opaque objects, and must be regarded as being very complete and efficient in its day.

Fig. 4 shows Divini's microscope (1667). The interest in this instrument is not in the mount, which is of the crudest form, but in the optical part, for in place of the biconvex eye lens two plano-convex lenses, with their



convex surfaces in contact, were used. This plan would halve the amount of the spherical aberration.

Fig. 5 exhibits an improvement on the preceding form, by Chérubin d'Orléans (1671). The body was more rigidly mounted by the enlargement of the tripod foot. A screw movement was fitted to the stage for focussing. In the optical part there is an erector. Chérubin d'Orléans was the first to apply an erector to his monocular microscope, and he was also the first to construct a binocular microscope. The binocular instrument would, according to the drawing, have given a pseudostereoscopic image.

In 1672 Sir Isaac Newton suggested a reflecting microscope of the form of a Herschelian telescope. It probably was never made.

Leeuwenhoek's microscopes, constructed in 1673, are remarkable more on account of the man who used them than for their design, which was crude in the extreme. It is indeed difficult to understand how the discoveries he made could have been carried out with such rude apparatus.

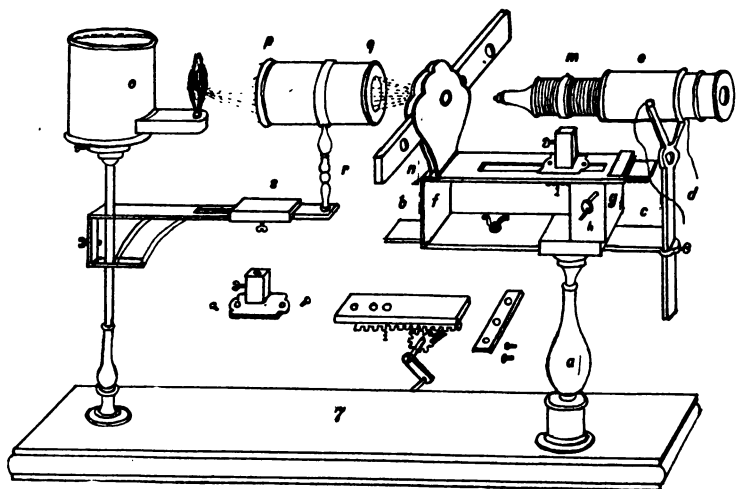
In 1687 we find a microscope by Grindl very similar to Fig. 5. The optical part, however, consisted of three pairs of plano-convex lenses.

In 1691 several new features appear. Fig. 6 shows a screw-barrel compound microscope by Bonanni. The slider placed between two plates pressed together by a spiral spring, was made to approach or recede from the objective by a screw. This simple arrangement, known as the "screw barrel," played an important part in the history of the microscope for upwards of 100 years.

To Bonanni we are also indebted for a horizontal microscope in 1691 (Fig. 7). This instrument is noteworthy, first for the double support to the body. A glance at Hooke's (Fig. 3) will convince anyone how rickety the body must have been when only held by its focussing screw, so here we have a decided improvement. Secondly, we have a rack, *i*, and pinion, *h*, coarse adjustment, in addition to the usual screw fine adjustment, *m*, of that period. There is also an improvement in the stage, and the last, and perhaps the most important novelty, is the compound substage condenser, *p*, *q*. Hooke's illuminating apparatus was, as we have seen, more suitable for opaque objects; this, on the other hand, is more adapted for the illumination of transparent objects. We now come to an excellent simple microscope by Hartsoeker, in 1694 (Fig. 8). It will be observed that the Bonanni screw-barrel focussing arrangement, *c*, *d*, is

maintained. The novelty, however, consists in the substage condensing lens, *e*, which can be focussed on the object by screwing, *f*, into the screw focussing tube. The important point in this arrangement is that the focus of the condenser is not disturbed while the object is being focussed to or from the magnifying lens. To Hartsoeker we are also indebted for a compressor.

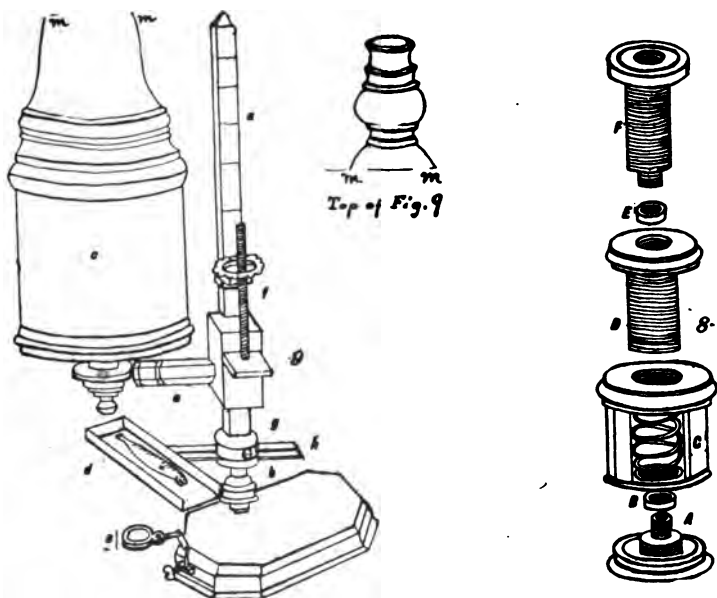
Wilson's screw-barrel, of 1702, then known as the pocket microscope, was a popular form of simple microscope in the 18th century; it was very similar to Hart-



soeker's, the main difference being that the substage condensing lens had no separate focussing adjustment. Culpeper subsequently mounted these microscopes on a pillar rising from a flat folding tripod foot, a mirror and condensing lens being attached; he also added a compound body to them. Later, in 1742, the Wilson screw barrel was mounted on a brass scroll fixed to a circular wooden foot, to which was attached a concave mirror. In this same year it is also stated that two diaphragms were supplied with the ordinary hand Wilson screw-barrel simple microscope, to fit in a cell close to the sub-

stage condenser, to reduce its aperture when high powers were used. This is the earliest notice of diaphragms for regulating the illumination.

In the year, 1702, we find a crude form of simple microscope by Mussenbroek. The only point of interest it possesses is to be found in a sector of graduated diaphragm holes. The purpose of these diaphragms was for diminishing the spherical aberration by cutting down the *apertures of the observing lens* and not for regulating the



illumination. The next model, that of John Marshall, 1704, takes us on several steps in the evolution of the microscope (Fig. 9). Here we first meet with the box-foot, a distinctive feature which lasted for nearly 130 years. The coarse adjustment is effected by a collar and jamb-screw sliding on a square bar, the fine adjustment by a direct acting screw, *f*. It is hardly correct to speak of the sliding arrangement as a coarse adjustment because the post, *a*, was marked with numbers corresponding

with similar numbers marked on the objectives ; the body remained clamped at the given mark until the objective was changed, all the necessary focussing being performed by means of the direct acting screw. The great advance made in this model consists in the pivoting of the lower end of the bar, *a*, on a ball and socket joint, *b*. As the stage, *d*, is also fixed to this bar it is obvious that when the instrument is inclined the stage is also inclined with it. This feature is totally distinct from the "telescope mount," and is one specially important in the evolution of the microscope.—Queket Club.

Examination of Water.

By GEO. C. WHIPPLE,

NEWTON CENTRE, MASS.

The microscopical examination of water is becoming every year a matter of greater interest, and the study of the minute aquatic plants and animals is more and more attracting the attention of scientists. These organisms are interesting for several reasons and, besides recognizing their importance in the domain of pure science, we are beginning to appreciate the great part that they play in nature and their effect, direct and indirect, upon the human being. Their presence in surface waters is often the cause of much harm when the water is used for purposes of domestic supply ; scores of instances may be mentioned where they have rendered the water entirely unfit for use. On the other hand, their presence in ponds and streams is of importance to the fish-culturist because they form the fundamental source of the food supply of fishes ; this is probably true both of salt and fresh water.

Because of the connection between the number of microscopical organisms in a cubic centimeter of water and the price of fish in our markets, the study of the 'plankton,' i. e., the floating micro-organisms, is being emphasized

on both sides of the Atlantic. Observers are beginning to trace the connection between the presence of microscopical organisms and the abundance of fish in our lakes and valuable comparisons have been made between the stomach and intestinal contents of fishes and the organisms found in the water where the catches were made. This work is of very great importance and should be vigorously pursued by our fish commissions. To be of the greatest value it should extend well over the country and include lakes and ponds sufficiently different in character to enable one to determine the laws governing the nature and distribution of the plankton in various climates and under various conditions. The study ought not to be carried on spasmodically, as, for instance, during the short vacation of some college professor who generously gives his time and talents to the cause, but should be undertaken seriously and continued throughout the whole year. Only in this way can we obtain the data necessary for a complete understanding of the subject.

Since water-works managers are equally interested in the microscopical organisms found in surface waters, and up to the present time have been responsible for most of the work done upon the subject, it might be possible for fish commissions, boards of health, water-works superintendents, and others interested, to work together according to a definite concerted plan, sending their results to some central commission or committee for comparison and study. Such an extended biological study taken in connection with meteorological records and observations upon temperature, transparency, etc., of the water would be of very great value. And it would seem that we have little excuse for neglecting to cultivate this fruitful field of research. Vast numbers of microscopical examinations are now being made. During the past eight years more than 40,000 have been made in Massachusetts alone, and the rapid growth of the new science of sanitary

biology is developing numbers of well-trained observers wide awake to the value of these problems and well able to undertake the work. What is needed is cooperation.

Various methods have been employed from time to time for determining the character and amount of microscopic life in water. Those interested in the subject from the piscatorial standpoint have usually employed some sort of net for straining the organisms from the water and concentrating them for the microscope. One of the best devices of this kind is that devised by Professor Reighard and used with good results for studying the plankton in Lake Michigan. It consists of a conical net of fine bolting cloth, at the small end of which there is a 'bucket,' made by covering a metal framework with some of the same bolting cloth. The apparatus is hauled through the water, filtering a column of water whose cross section is the same as the circular mouth of the net and whose length is equal to the distance through which the net is hauled. The organisms are caught by the fine bolting cloth and are ultimately washed into the bucket. The collected material is then removed by an ingenious arrangement, measured and sent to the laboratory for microscopical examination. By this method one is enabled to get a good idea of the total amount of suspended matter in the water, but it can hardly be called an accurate method of obtaining the number of living organisms present, as the net sweeps in amorphous matter as well as organisms and some of the smaller forms undoubtedly escape through the bolting cloth. Moreover, the amount of water actually filtered cannot be told with a great degree of accuracy. Nevertheless, the method is one of value, particularly for securing the larger and rarer forms of rotifers, crustacea, etc.

Sanitarians who have studied the microscopical organisms in water supplies have usually employed very different methods from the above, partly because they have

been interested more especially in the smaller forms, but chiefly because their operations have been confined to the small quantities of water sent to the laboratories for analysis. During the last decade the old methods of sediment examination have given way to the filtration methods. The Sedgwick-Rafter method, which is most used at the present time in laboratories of water analysis, is carried on as follows:

A portion of the water to be examined is measured out in a graduate and filtered through a thin layer of quartz sand placed at the bottom of a glass funnel upon a perforated rubber stopper, the hole in which is capped with a disc of bolting cloth. When the water has filtered the organisms will be found upon the sand while the filtered water will be free from them. The rubber stopper is then removed and the sand washed into a test tube, with a measured quantity of distilled water delivered from a pipette. Usually 250 or 500 c. c. of the sample are filtered and the sand washed with 5 c. c. The test tube is then thoroughly shaken and the water decanted into a second tube; the organisms being lighter than the sand, will pass off with the water, leaving the sand clean upon the walls of the first tube. In this way the organisms are concentrated 50 or 100 times. One c. c. of this concentrated fluid is then transferred to a counting cell, which just holds it and which has a superficial area of 1,000 sq. mm. After putting a thin glass cover-slip over this cell it is transferred to the stage of the microscope for examination. The eye-piece of the microscope is fitted with a micrometer in the shape of a ruled square of such a size as to cover one square mm. on the stage, i. e. one thousandth of the entire area of the cell. The organisms observed within the limits of the ruled square are then counted and the cell moved until another portion comes into view, when another count is made. Thus 10 or 20 squares are counted and the number of organisms

present in the sample can then be calculated very easily.

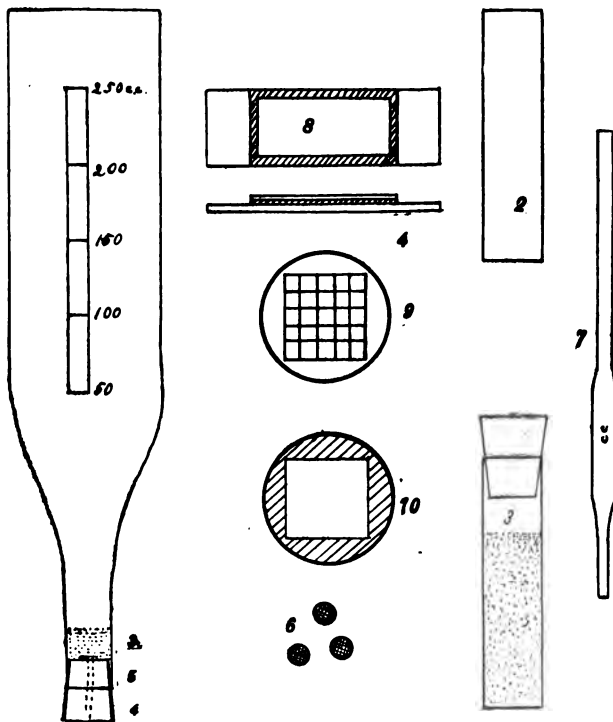
This process has many things to be said in its favor, and it is undoubtedly the best all-around method for the study of the plankton. The apparatus required is simple, inexpensive and not liable to get out of order. The process is neither long nor difficult, and if care and cleanliness are observed in the manipulation very accurate results may be obtained. Ordinarily the quantity of water operated upon is small, but there is no reason why large filters may not be used. The writer has frequently used a funnel having a neck one inch in diameter, filtering from 1,000 to 10,000 c. c. This, when used with an aspirator to hasten the filtration, has given excellent satisfaction. The chief objection to the Sedgwick-Rafter method is that delicate organisms are liable to be crushed upon the sand, and this danger is naturally somewhat greater when this aspirator is used. It is probably no greater, however, than in Reighard's net.

Recently a new apparatus has been devised for the study of the microscopical organisms, known as the planktonikrit. This is a modification of the centrifugal machine and depends upon the fact that the specific gravity of the organisms is different from that of water. It has the advantage of avoiding, to a certain degree, the crushing of the delicate infusoria, but it is somewhat inaccurate in the case of some of the lighter organisms; furthermore, it operates upon very small quantities of water.

In a complete study of the microscopical organisms, such as might be undertaken on our great lakes, for example, it would be advisable to use all three methods adopting the Sedgwick-Rafter method for general quantitative work, but using the net and centrifugal apparatus for determining the rare and delicate organisms.

As there are many lovers of the microscope who are interested in studying aquatic life, and as there are many

others connected with water-works to whom the study of algæ and infusoria would be of much value, the writer has tried to reduce the Sedgwick-Rafter method to its simplest possible elements in order that it may be more generally used. Furthermore, it is often necessary for the sanitary biologist to be provided with a portable outfit for work in the field. There are many fragile organ-



isms which will not bear transportation to the laboratory. *Uroglena*, for example, a very important and troublesome organism found in water supplies, goes to pieces completely when kept for a short time in a stoppered bottle. It is, therefore, necessary to make the examination of water immediately after the collection of the sample.

The chief modification of the method for field work

consists in the use of a cylindrical glass funnel (fig. 1) similar to the one designed by Mr. D. D. Jackson for the Massachusetts State Board of Health, but different from it in having a capacity of 250 instead of 500 c. c. and in having graduations marked upon the sides. This funnel may be conveniently carried and its graduation renders the use of a second measuring glass unnecessary. When in use it may be supported on a wire frame, which any ingenious person can make. In place of the test-tube it has been found convenient to use tube vials (fig. 2) having square ends. These require no racks and are not easily tipped over. The pipette for washing the sand might be dispensed with if one of the tube vials was graduated, but as much depends upon accuracy in concentrating the sample it is best to use a short pipette (fig. 7). The sand (fig. 3) used in the filter should be perfectly clean and of such size that its grains will pass through a sieve having 60 meshes to the inch, but not through one having 100 meshes. Crushed quartz makes the best filtering material and should be used when obtainable. The discs of bolting cloth (fig. 6) may be easily cut out with a wad cutter. The filtered water may be used for concentrating the organisms, or it is possible to employ preservative fluids in case the microscopical examination must be deferred or it is desired to keep the specimens. The cell (fig. 8) for holding the concentrated fluid may be made by cementing a brass rim to an ordinary glass slip. It should be 50 mm. long, 20 wide and 1 mm. deep, thus holding just 1 c. c. and having a superficial area of 1,000 sq. mm.

A very simple microscope will answer for this work. A large stand is too valuable and too heavy for the rough usage in the field, and a cheap, light stand with a $\frac{1}{2}$ inch or $\frac{3}{8}$ inch objective and a No. 3 ocular will answer equally well. The ocular must be provided with a micrometer, so that the observer may count the number of organisms

in one cu. mm. of the cell. A disc of glass ruled as in fig. 9 is the best form of micrometer, but a piece of thin metal with a square cut out, as shown in fig. 10, may be substituted. In either case the square must be of such a size that it covers one sq. mm. on the stage with a given combination of objective and ocular, and a certain tube length to be found by comparison with a stage micrometer. It is an advantage to have at hand higher powers for a more thorough study of the organisms met with, but for ordinary work the powers suggested are sufficient.

All this apparatus, together with bottles for collection and note book for records may be carried in a grip sack, and this will be found generally the most convenient way. It is possible, however, to make a neat box, with compartments for holding the microscope, funnels, tube, vials, etc., and I respectfully submit this to manufacturers of microscopical supplies.—Science.

Astronomical Photography with Photomicrographic Apparatus.

A. CLIFFORD MERCER, M. D.

SYRACUSE, N. Y.

On the twentieth of October, 1892, occurred a partial eclipse of the sun, and my heliostat was placed on a shelf outside a south window. Within the room was a portrait lens of eight inches focus and a microscope in the small axial line. The substage condenser was removed and a camera connected with the eye end of the microscope tube. Such sunlight as fell on the mirror of the heliostat was reflected through the portrait lens. The portrait lens projected an image of the clouded sun's disc, about one-twelfth of an inch in diameter, in the plane usually occupied by an object on the stage of the microscope. This tiny image was itself projected by

a microscope objective of an inch and a half focus to form a second image, two inches and three-eighths in diameter, on the ground-glass of the camera. The clouds made sharp focusing impossible. Only an imperfect focus was obtained. The clock of the heliostat kept the image steadily on the ground glass.

During the eclipse sensitized plates were substituted for the ground-glass. Exposures were made when the clouds were thin enough to permit. Thus six negatives were secured. The first print shows the moon's black disc, advancing apparently from the north-east across the sun's disc, while the second shows the moon's disc, passing off to the west.

This is the first record of an attempt to use photomicrography astronomically. All of the necessary apparatus could be easily packed in a trunk. If an unaided telescope objective were used to project an image of the size obtained, a focus of twenty-one feet would be required; and the lens would have a diameter of about sixteen inches. Such an objective properly mounted would result in an instrument nearly half as large as the great Lick telescope, with its photographic objective. By using a portrait lens having a focus of fifteen or sixteen inches, a size commonly used for "cabinets" in photographers' studios, instead of the portrait lens, the apparatus will produce a negative image equal in size to that produced by the unaided Lick lens; or, leaving the portrait-lens in place, the same result could be obtained by substituting for the microscope objective of one inch and a half focus, another of about double the power,—one of three-quarters of an inch focus. The Lick instrument has a tube about fifty feet long and forty-two inches in diameter, while this apparatus has two tubes less than one foot long and about one inch and six inches in diameter respectively. To the smaller tube is attached a camera with a bellows extending from one to six

feet. Stability and freedom from vibration are very easily obtained with the small and short apparatus. The difference in cost is enormous. In several respects the photomicrographic arrangement has advantages over the great Lick photographic instrument.

If, however, we turn to the matters of light and separating power, the very great superiority of the Lick objective is seen. The results given in the following tabular comparison are only approximately accurate. The loss light suffers by absorption as it passes through glass and by reflection at incident surfaces, is not taken into account;—the Lick objective consisting of three thick lenses and the photomicrographic arrangement having more than twice as many, but comparatively very thin, lenses and the mirror's reflecting surface:

	Lick Objective.	Larger Portrait Lens.	Smaller Portrait Lens.
Diameter of objective.....	33 in.	3.75 in.	2 in.
Focus of objective.....	550 in.	15 in.	8 in.
Focus divided by diameter.....	16.66	4	4
Relative value of light in first image.....	1	16	16
Size of first image.....	5.1 in	.1395 in.	.0744 in.
Total equivalent focus, 550 in- ches, divided by diameter.....	16.66	147	275
Relative value of light in final image.....	1	$\frac{1}{77}$	$\frac{1}{277}$
Time of exposure, eclipse of sun (about)	$\frac{1}{1600}$ sec.	$\frac{1}{20}$ sec.	$\frac{1}{5}$ sec.
Separating power.....	1	$\frac{1}{88}$	$\frac{1}{16.66}$

Other things being equal, separating power varies with the aperture or diameter of the objective. If the Lick objective, having an aperture of thirty-three inches, could barely show a certain double star as two distinct stars, it would be impossible for any objective having an aperture of four or two inches to show such a double star as two distinct stars. A star apparently single when seen through any objective having an aperture of two

inches might be seen to consist of sixteen or seventeen stars in line, almost touching one another when seen through the Lick photographic objective. A star apparently single when seen through any objective, having an aperture of three inches and three-quarters might be seen to consist of eight or nine stars in line, almost touching one another, when seen through the Lick photographic objective. The power of resolving an apparent single star into two or more, or of showing the details of sun spots or other objects, is known as separating power. A superior correction of aberrations is now possible in lenses made of small discs of glass which are produced in great variety as to optical properties, a variety not yet realised, in large discs.—Tr. A. M. S.

Progress in Effects with the Roentgen X-Rays.

To see through a person in a metaphorical sense has been the wish of most people at some time or another, but it has now become a literal fact by means of the occult rays, popularly known as the X-rays (on account of their exact properties not being understood), discovered by Professor Roentgen of the University of Wurzburg. It seems inexplicable that with the art of photography, so highly developed as it has been for many years, and with the experiments that have been taking place in laboratories all over the world in radiant matter in vacuum tubes, that we should have had to wait for the year 1896 for this discovery to have been made practically available ; it only leads us to reflect that "there are more things in heaven and earth than are dreamt of in our philosophy," and that there is yet room for fresh and startling inventions and discoveries.

The first announcement of Prof. Roentgen's discovery that rays from a Crooke's or Lennard's tube of high vacuum had a power of penetrating numerous substances,

such as wood, leather, flesh, etc., which hitherto had been classed as opaque, was received with incredulity, but the circumstantial description of the methods employed enabled persons possessing the requisite instruments to repeat the experiments and to confirm the report. Not the least important aspect of the discovery was, that it was likely to prove a valuable means of contributing to the relief of some of the ills to which flesh is heir, by exhibiting details of bony structure of the living subject, bone being opaque to these rays, while flesh is practically transparent.

Two special features are associated with these X-rays, (a) that the emulsion on an ordinary photographic dry plate is sensitive to them, and (b) that certain chemical salts become fluorescent, that is, appear aglow with light under their influence.

Let us examine these features in detail. Prof. Roentgen found that if a photographic dry plate were enclosed in a wooden box, and a coin were placed on the outside of the box with the vacuum tube above, on the tube being excited by means of an electric current the X-rays penetrated the wood, (which is practically transparent to them) but not the coin, with the result that the image of the coin appeared on the plate inside the box on its being developed. In like manner, if the hand were placed on the box, the bones being opaque to the rays were shadowed on the dry plate.

The title of photography as ordinarily understood was not applicable to these effects, and the name of radiography was, after considerable discussion, given to the process. It at once became apparent that a large field for investigation and experiment had been opened, and it was not long ere the London hospitals were employing the X-rays for the investigation of bone diseases and fractures, and for ascertaining the exact position of foreign bodies, such as bullets, shots, needles, etc., in the

flesh with the view to their easy and speediest removal.

We have already shown in this periodical the bones of the hand of an Egyptian Mummy, radiographed through the wrappings, flesh, etc., the structure being exhibited beautifully. Herewith is a radiograph of a fracture of



the Olecranon process of the elbow, and a radiograph of the human hand will appear as frontispiece next issue.

Great difficulty was experienced in the early days in penetrating deep structure; and radiographing ribs, vertebræ, etc., presented considerable difficulties, but as the

results of experiments, improvements were made in nearly all the apparatus that was necessary, and quite recently Dr. Macintyre of Glasgow, Scotland, has successfully radiographed a calculus of the kidney en situ which was subsequently found to have been precisely delineated on the operating table. The same gentleman has also successfully radiographed the ribs and vertebræ of adult men, obtaining at the same time faint outlines of important organs, particularly the heart, in one case of which an enlargement was distinctly portrayed, but we are to have further developments yet.

An interesting feature in connection with the Roentgen rays is its usefulness in detecting imitation gems both diamonds and rubies being transparent to the Roentgen rays, while imitations in glass or paste are opaque to them. Already a considerable use has been made of this aspect. The process is also exceedingly useful for examining the contents of postal packets, anything of a metallic nature being at once detected if contained in a wooden box. The only protection against such a revelation is of course to pack goods in a metal box through which the rays will not penetrate. It is rumoured that instruments are already in use in the General Post Office, London, for examining packets and the English War Department has invested in a considerable number of sets with a view to locating bullets on the battle field and so saving the painful and tedious operation of probing.

THE FLUORESCENT SCREEN:— It was remarked that under the influence of the X rays certain chemical salts have the power of becoming brilliantly illuminated and of rendering visible objects which are opaque to the rays that are interposed between the vacuum tube and the fluorescent screen. For instance, if the hand be placed between the fluorescent screen and the vacuum tube the bones will be distinctly shadowed on the screen while the flesh will be almost transparent, if the body be interposed

the ribs and vertebrae will be distinctly visible. Several materials have been suggested for the manufacture of these screens but probably the most successful has been Platino-cyanide of Potassium. This salt, however, varies very considerably in its fluorescent properties and quantities from the same manufacturer purchased at separate times do not yield uniform results. The method of preparation is as follows: The Platino-cyanide is ground as finely as possible with a pestle and mortar. It is then mixed with weak clear gum water and spread evenly upon a thin sheet of cardboard. One coat alone at a time should be given and allowed to dry; two or three coats are usually sufficient. Owing to the expense of the material and the chances of failure in preparing, it has usually been found more economical to purchase ready made screens. Calcium tungstate was the material suggested by Edison for these screens but it does not compare favorably with Platino-cyanide of Potassium.

A new screen has recently been placed on the market by Watson & Sons, London, which surpasses in brilliance others that have been so far made. The material is a secret preparation but with a good focus tube it enables the bones (ribs, vertebrae, etc.) of an adult person to be seen clearly.

APPARATUS:—At the outset extravagant rumors were set afloat as to the cost of the necessary instruments, but the outfit has now been reduced to a battery, an induction coil and a vacuum tube.

Additional but not absolutely necessary apparatus, would be a holder for the tube, and a fluorescent screen. The battery may consist of either Bunsen's or Grove's bells or a 4 cell accumulator giving 8 volts and a current of about 8 amperes.

THE COIL:—A Ruhmkorff Induction Coil giving a 3 inch spark only is sufficient for obtaining Radiographs of the arm, leg, etc. but if deeper structures are to be dealt with

it is well to have a coil giving a greater length of spark, say 6 inches. The tube is much more brilliantly illuminated with such a coil, exposure is shortened and deep structures more easily penetrated. There is another reason also why so large a coil as a 6 inch should be taken. With use the vacuum of a tube becomes higher and is consequently more difficult to excite. Warming with a spirit lamp will reduce the vacuum but it is not nearly so satisfactory as being able to excite the tube direct from the coil.

THE TUBE:—More failures in working have been due to defective tubes than to anything else, in fact a large majority of the tubes that have been sent out have been absolutely worthless. It is unwise to buy any tube without a guarantee of its suitability and perfection in working and where such a guarantee is obtained the price is usually somewhat high. Still it is better to pay a fair price for a good article than to have several unsatisfactory tubes at a low price.

As tubes are somewhat liable to damage it is well to be provided with two or three. No absolute statement can be made as to the length of life of a tube. The writer has one in use which has been constantly employed for the past three months and is as good as ever, while others have sometimes failed in some particular after a very short period of use. We have experimented with tubes by all makers and have spared no expense in having the latest patterns as they have been issued, but in our hands the focus tube as manufactured by W. Watson & Sons surpasses every other kind both for the fluorescent screen and for radiographic effects.

There is no doubt that the whole process is in its infancy and time alone will show in which direction further successful progress in the methods will be made. Supplementary apparatus will also appear to augment its usefulness.

EDITORIAL.

Laboratory.—The best equipped and most complete bacteriological laboratory on the Pacific coast is owned and conducted by Prof. S. M. Mouser, at 707 Bush street, San Francisco. Professor Mouser has devoted many years of his life to the study of this comparatively recent, but rapidly growing science. He has secured all the latest instruments and scientific appliances, and is constantly in receipt of all the important pathogenic bacilli cultures for experimental, teaching and therapeutic purposes. It is gratifying to note that the Professor's labors are appreciated, notwithstanding that many of our ancient confreres are still scoffing at the science. Besides being Professor of Bacteriology and Pathology in the College of Physicians and Surgeons of San Francisco, Dr. Mouser daily conducts large private classes in bacteriology and pathology at his laboratory, as well as doing private analytical work for the profession on the coast.

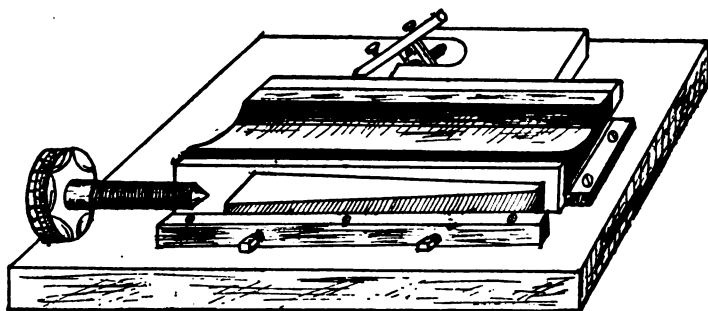
The Danger from Bovine Tuberculosis.—Dr. W. L. West of Ellsworth, Me., has reported to Dr. G. H. Bailey that two children of a man named Luther Bridges have recently died of tuberculosis, due to drinking milk from a cow which was found, when killed, to be the subject of extensive tubercular disease, localized in the udder. Five of Bridges' nine children are suffering from pulmonary tuberculosis and several are now, according to the report, fatally ill.

MICROSCOPICAL APPARATUS.

Micrometer Rulings.—On May 21st, 1897, there was exhibited before the New York Microscopical Society a very simple piece of mechanism for producing fine rulings on glass. The inventions hitherto employed for this purpose have been elaborate and costly, while on this article from the labor of an ordinary machinist the cost was less than five dollars. To rule lines accurately up to fifty

thousand to the inch and more by such an appliance seems almost incredible.

The inventor, Rev. D. W. Smith, of Brooklyn, N. Y., having need of some work of this kind to assist him in certain experiments, with a few pieces of metal and glass evolved the machine referred to. He states that, beyond forty or fifty lines to the inch, the task of ruling lies more



DESCRIPTION OF FIGURE.

A.—Micrometer screw operating upon the base of the movable wedge.

B.—Movable wedge, adjusted by set screws working in contact with strips of plate glass.

C.—Brass block, having only lateral movement caused by the thrust of the wedge.

D.—Diamond carrier, easily adjusted to any position and weight necessary for any degree of cutting, and moved laterally by the brass block and longitudinally by hand.

E.—Graduated drum upon the micrometer screw.

F, F.—Iron base supporting the entire apparatus.

The following parts, for distinctness, are not represented in the figure A broad clamping nut supporting the micrometer screw; an index for the graduated drum; and the retaining springs holding the movable portions in contact.

in the proper selection of diamond points or crystals, necessary for lines of the required fineness, than in the accuracy of the machine.

The principle involved is that of a screw, operating upon a wedge of brass, moving the latter longitudinally on the supported bed. The screw contains sixty threads to the inch, which number is by no means an arbitrary one. For the wedge is capable of adjustment by means of set screws

which serve to correct its movements to correspond with the inch or millimeter to be ruled. In this case one revolution of the screw moves the wedge so that its lateral displacement is equal to one one-thousandth of an inch. This lateral displacement of the moving wedge operates on a block of brass resting on three points projecting from its base. By the side of this block of brass is operated the diamond carrier. The points of contact for the entire system of screw, wedge, block of brass and diamond carrier, operate upon pieces of plate glass—plate glass strips where contact points move on wedge and block, and plate glass bed resting on an iron base, which supports the longitudinal and lateral movements of the block of brass and the diamond carrier. This give a smooth and accurate motion to all the working parts, which could be otherwise obtained only by expensive and carefully polished steel surfaces.

This is a general description of the first working model so far as is known, using the principle of the wedge as a means of adjustment and correction, and of imparting the motion of a decreasing gear from the screw which is necessary for such work. A considerable motion of the screw is thus given for minute divisions, thereby ensuring uniform and accurate rulings.

The device for carrying the diamond, as first used, was a single carriage, moved back and forth by hand along the glass bed plate, and held in its place to the brass block by means of contact springs. Afterwards for convenience, a triple link carriage was made, that is, three separate parts hung by three trunnion points of hardened steel accurately turned. Though much more scientific and easier of use the results, up to thirty or forty thousand lines, was hardly worth the trouble of its construction, save the chance of any disturbance of the diamond point by accidental handling of the diamond during ruling.

With a little more trouble the entire arrangement could be easily adjusted to become entirely automatic in its movements, whereas in the present model the move-

ment of the screw and that of the diamond carrier requires separate and distinct operations. With the screw thus connected a motion is given to the diamond covering a space of about one-fifth of an inch in width. Thus a screw sixteen inches long would give movement enough to rule a spectrum band one inch square.

MICROSCOPICAL MANIPULATION.

Drinking Water.—Schumburg has thoroughly gone into all known methods of purifying drinking water, and finds that bromine is the only disinfectant which can be removed after serving its purpose, without spoiling the appearance and taste of the water. The quantity of bromine used is very small; 1 kilogramme is sufficient to sterilize 16,000 litres of water. The author uses the bromine in the following solution:—Water, 100; potassium bromide, 20; bromine, 20. 0.2 C.c. of this solution is sufficient to sterilize in five minutes 1 litre of water from the river Spree. The calcium salts or ammonia of very impure river or surface water use up some of the bromine before it has had time to develop its disinfectant properties. In such cases enough must be added to cause a slight yellow coloration of the water, which should last at least half a minute. The 0.2 C.c. of bromine solution may be removed by adding an equal quantity of 9 per cent ammonia.—*Pharm. Zeitg.*, xlii., 174.

BACTERIOLOGY.

Baldness.—Dr. Sabouraud, in the *Annales de Dermatologie*, firmly believes that the disease is contagious, and that barbers' instruments are the most common carriers of the contagion; but as customers come and go from one barber to another, it is difficult to trace each case to its source. Starting with the theory of the microbic origin of the disease, Sabouraud has worked out a strong chain of evidence in its support. He tells us that the typical hair of Alopecia areata is found at the edge of an advancing patch,

and is a stump of long hair that has remained in the scalp. It is club shaped, or like an interrogation point. Its diameter becomes less as we go towards the root, and its color is lost. These hairs are always a sign of an advancing patch, and are not found in old patches. The medullary (or pit) canal of these hairs is normal above, altered in the middle, and it is completely wanting at the root. The root is not bulbous and hollowed for the papilla, but in the form of a turnip. . . . Utricles that are full and closed are found among the sound hairs. They are filled with joined strata of epidermic cells, and contain in their centers, like a larva in a cocoon, compact clusters of microbes, a pure culture of the smallest bacillus known.

. . . As it grows old it may be one quarter millimeter (0.01 inch) wide and one-half to one millimeter long, and comma shaped, or bent. The young bacilli are a little swollen in the center, and their ends are blunt. . . . Each utricle contains millions of them. . . . This bacillus is regarded as the most probable cause of the disease.—*Sci. Am.*

Leprosy.—Leprosy furnishes the best opportunity for studying a parasite of a bacterial nature. The relation of the cells can be plainly shown, since they do so little damage. Regarding the phagocyte theory: As Dr. Rosenstirn says, inert substances can be taken up by the leucocytes. It has been said that the bacteria that we stain are dead; that they have a keratin-like envelope capable of dying. In several forms of leprosy they are hard to find, especially in erythematous cases. The discovery of bacteria floating free in the blood is not new. It is remarkable that they can float through the kidneys and do no damage, but they seem to take up in certain tissues; for instance, the eye-brows, and not the scalp.

It is the consensus of opinion that a leucocyte cannot pick up a bacterium unless it be dead; it being a process of digestion. The action is such that if the bacterium remained there long alive, either one or the other must die; they are so antagonistic to one another. There is no reason why the leucocyte cannot take up 30 or 40 bacilli.

Caseous Rhinitis.—During the last year or two Prof. Guarnaccia (*Archivii Italiani di Laringologia*, No. 4, 1896) has made bacteriological researches upon caseous rhinitis. These studies refer to a case observed by Massei in his clinic. Guarnaccia has demonstrated that the micro-organism found in rhinitis caseosa, which was so differently understood by Perier, Sabrazes, etc., is streptothrix alba, or Foersterii, studied by Rossi-Doria, Cohn, and Gasperini. The author was able to cultivate it in agar gelatin, bouillon, blood-serum, potatoes, and milk. Inoculations in animals were not successful. It is perfectly correct, in his opinion, to assume that the considerable amount of caseous matter is formed by the growth of the streptothrix, as is the case in muguet.—*Universal Medical Journal*.

Tuberculosis in Goats.—From the following it will be seen that the hitherto accepted theory that goats are immune to tuberculosis is not altogether correct. Bulling (*Indian Medical Record*) records a case of pulmonary tuberculosis in a goat. Both lungs were adherent, and large and small tuberculous foci were present. The author concludes that it would be well to examine into the possibility of the transmission of tuberculosis through the agency of goats, and to consume their milk only after boiling, or after the goat has been shown to be free from tuberculosis by the absence of reaction after the injection of tuberculin.

MICROSCOPICAL NOTES.

Circulation of Blood.—Most books recommend the use of a frog's foot for this purpose and give directions for accomplishing the purpose. The object may easily be attained with a small tadpole, lizzard, and with many of the larger water larvae. The latter will show the circulation all through the body. With the lizzard and tadpole, it may best be seen in the thin membranes of their tails. All that is necessary is to place the animal in a glass slip with a shallow cell and cover it.

MICROSCOPICAL SOCIETIES.

American Microscopical Society.

The 1897 Meeting.—It was held at Toledo but owing to the attraction of the A. A. A. S., and the British Association at Toronto and the lack of preparation for the meeting it proved almost an entire failure. The Toledo papers paid almost no attention to the matter and sent no reporters to the meeting. From two short notices in the Toledo Blade, however, we are able to glean the following:

Thursday August 5.—Meeting opened in the High School building with an address by the President, E. W. Claypole, upon "Microscopic Light in Geological Darkness." Only a small number of persons were present they being mostly Toledo microscopists and their friends. An informal talk or "reception" followed the address.

Friday Aug. 6.—The meeting for business commenced at 9:30 a. m., (with a dozen present), and after unimportant matters had been discussed, Prof. D. S. Kellicott of Columbus, Ohio, spoke on the "Capture and Study of Rotifers." Miss Edith J. Claypole, a daughter of the President read a technical paper on "Comparative Structure of the Digestive Tract." Francis L. Rice, of Steelton, Pa., had expected to present a "microscopic examination of steel."

Friday P. M.—No meeting. The visitors were escorted about town by citizens to see "various points of pleasure and interest."

Friday Evening.—Soiree. All the available microscopes in Toledo were brought to the Library Building and the miscellaneous public were shown the usual wonders of the invisible realm. "Every body who has any interest in these matters should avail themselves of the opportunity," was the invitation to the public. "The public except small children, is cordially invited." "There were nearly 100 instruments of all sizes the lens of some of them being extremely powerful."

Saturday Aug. 7.—The sessions closed with the election

of officers and the reading of two papers. No new persons being available for president it was thought wise to elect one of the early presidents again.

The list for 1897-8 is as follows :

President, D. S. Kellicott.

Vice-President, Mrs. S. H. Gage.

“ V. A. Moore.

Secretary, Dr. W. C. Krauss.

Treasurer, Magnus Pflaum.

Committee, Dr. D. E. Haag, Edith Claypole,
and John M. Berry.

The Secretary and Treasurer are hold-overs.

A paper was then read by Agnes M. Claypole on “Forms of Cleavage in eggs of certain Arthropods.” The other paper of like technical character was by John M. Berry of Peterboro, N. Y., on “Phagocytic Action of Leucocytes in Amphibians and Mammals.

The society then adjourned to meet at such time and place as the committee may hereafter agree upon. It seems that no invitations were received by the society for next year and no exhibits, working sessions, excursions or banquets were connected with the meeting this year. The Blade says : “While the attendance was not so large as had been anticipated the interest of those present was none the less apparent.” It also announces that one enthusiast, J. C. Smith, had come all the way from New Orleans, to attend and that there were two or three people from Fort Wayne, Ind.

Certainly the thanks of Toledo are due to the Professor Claypole and his two daughters, without whose presence the meeting would have lost largely and whose papers constitute in bulk three quarters of all the mental pabulum furnished the visitors. The Blade properly acknowledges this by saying : “Perhaps the best known microscopists in this section are Prof. Claypole and his two daughters, who are always among the leaders in any event that tends to create microscopic interest.”

Our society is indebted to Dr. D. E. Haag for securing the school room for its use and for working up the exhibi-

tion of objects at the Soiree. It appears to have shown its thankfulness by electing him a member of the Executive Committee, while the other two members earned their places by reading papers.

If the Secretary will confine the Proceedings to the actual occurrences at Toledo, we are of the opinion that his fond hope of having them out by Christmas ought to be realizable. But if he waits for absent members to write some papers with which to eek out a report, he will perhaps be delayed till next spring or summer.

NEW PUBLICATIONS.

Elementary Zoology and Laboratory Guide.—By H. E. Chapin and L. J. Rettger., Chicago, 1897, 212 pp., 145 figs. 8 vo.

In the preface, our authors significantly remark: "A teacher who expects to do no more than read the following pages is begged to close the book at once and turn his attention to more profitable things. "A teacher who would merely assign three pages in advance each day had better exchange the book for an almanac or a treatise on Chinese."

This book then is not to be memorized and recited. You are to go into the laboratory and museum and study objects of Natural History. Perchance this book will help you—that all depends on you. The book is all right : are you ?

Chapters are devoted to Protozoa, Porifera, Coelenterata, Echinodermata, Vermes, Molluscoidea, Mollusca, Arthropoda, Vertebrata, and Laboratory methods. Embryology and minute structure are not much touched upon, the scope of the book being microscopic largely. We heartily commend it to the notice of all teachers.

A few pages on the microscope contain the rudiments of knowledge needed by the beginner. Hardening and mounting media are described briefly, so is embedding, section cutting, etc.

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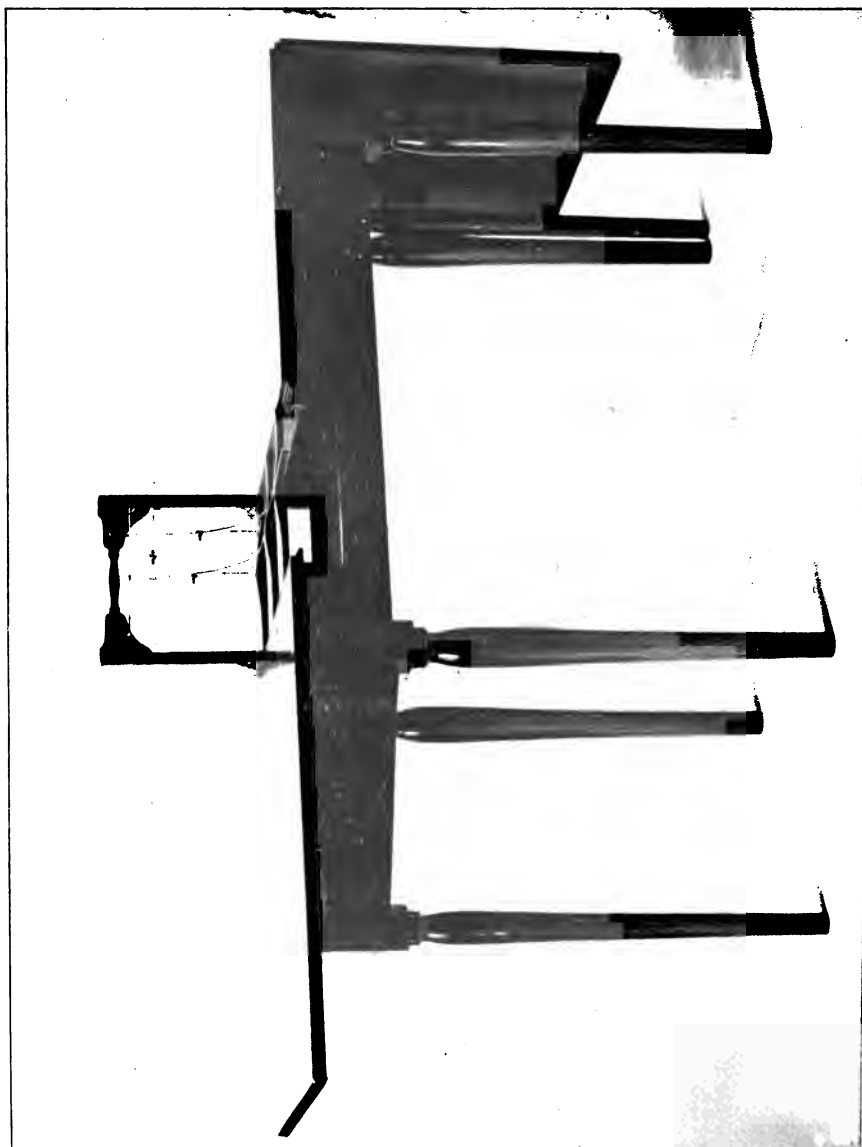
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THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. XVIII.

DECEMBER, 1897.

No. 12.

Parasitic Leaf-Fungi.

BY REV. ALEX. S. WILSON.

About the time when the blackberries are ripe, after a short search one can generally find a bush the leaves of which have a paler appearance than ordinary; closer inspection shows the under surfaces of the leaves flecked here and there as if with specks of soot. With the aid of a pocket lens each speck is seen to consist of tufts of little club-shaped bodies, and if we scrape some off, mount them on a slide, and place it under the microscope, we see that they are cylindrical cells, each made up of from three to eight joints, and supported by a short stalk. Their form is so characteristic that, once seen, there is no difficulty in recognizing it again. These are the telutospores of the bramble brand (*Phragmidium violaceum*), a parasitic fungus belonging to the order *Æcidiumycetes* (or *Uredines*), all of which inhabit living plants.

The leaves of various species of mint are in autumn often dotted over in like manner with dark-colored spots, due in this case to the telutospores of *Puccinia menthæ*, each composed of two joints of hemispherical form. By this two-celled character the *Puccinia* genus is distinguished from *Phragmidium*, which has telutospores usually consisting of more than three joints. On the meadow-sweet a brand, *Triphragmidium ulmariae*, occurs, having three-celled telutospores; those of the brands

which affect the bean, pea, clover, and lady's-mantle, species of *Uromyces*, are uni-cellular. *Gymnosporangium* (*Rostelia*) growing on junipers has them two-celled, closely packed, and embedded in gelatinous substance : they are prismatic, and form a compact layer in *Melampsora* infesting the leaves of the willow and sunspurge ; and the species of *Colesporium* living on the colt's-foot and eye-bright have four-celled telutospores united to form a compact, waxy stratum, surrounded by a gelatinous mass. The characters presented by their telutospores thus form the basis of the classification usually followed in this group of fungi, the spores of which, indeed, constitute the principal feature.

Telutospores are resting or winter spores ; only in a few cases are they capable of immediate germination. The name derived from *telos*, "end," indicates that their production is regarded as completing the life cycle of the fungus. Unlike other spores, which on germination give rise to a branching mass of thread-like cells known as a mycelium, which is really the vegetative body of the fungus, a telutospore only develops a short filament or promycelium, on which arises small reproductive cells, the sporidia ; the latter are able at once to germinate and form mycelia.

Minute yellow streaks may be observed during the latter half of the year on the leaves of all our common grasses, especially on the lower leaves, by anyone who will take the trouble to look for them. On examining these with the pocket lens they are found to be chinks in the epidermis of the leaf filled with orange-coloured dust. Under a microscope of low power, with direct light, a small piece of grass-blade so affected presents a charming appearance. The dust is seen to be composed of orange red globules, having a waxy lustre or bloom, reminding one of artificial fruits, and forming a splendid contrast to the bright green chlorophyll grains of the

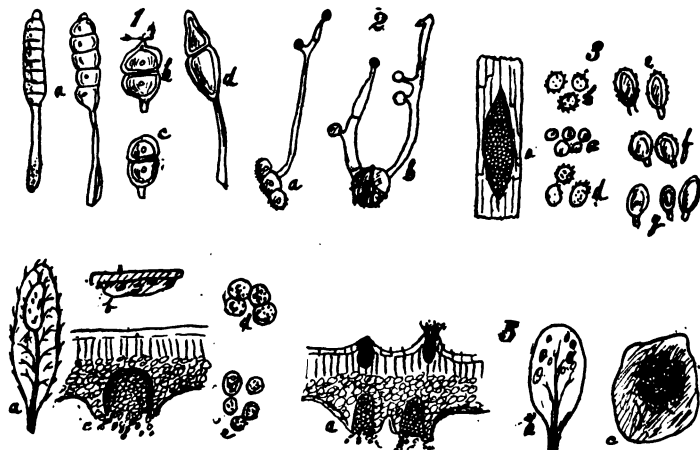
leaf. With careful focussing under a higher power, minute projections studding the surface of the spores become visible, giving them a bristly appearance. These are the summer or uredospores of a parasitic fungus now designated *Puccinia rubigo vera*, one of the corn-rusts which occasionally inflict so much damage on cereal crops. *Puccinia graminis* injures the wheat; allied species occasion the orange and scarlet patches of rust seen on the rose, barren strawberry, eye-bright, cow-wheat, sow-thistle, groundsel, thistle, harebell, nightshade, dog's mercury, and many other native plants. The name uredospore (*uro*, "I burn") has reference to the conspicuous disfigurement and often burnt appearance of leaves attacked by these fungi. Unlike telutospores, the uredospore germinates at once if placed on a suitable host, and gives rise to a filament which penetrates the epidermis and develops into a mycelium, extending through the intercellular passages of the leaf. Uredospores commonly appear somewhat earlier in the season than telutospores, though the two often grow together.

On gooseberries our readers may sometimes have remarked a bright yellow spot about the size of a sixpence. Similar spots occur on the leaves of gooseberry and currant bushes. The lens shows that they consist of a number of small round openings full of orange powder; these are the cluster-cups and æcidiospores of *Æcidium grossularia*. An exceedingly common species, *Æ. compositarum*, is found on the lower surface of the colt's foot leaf, a plant abundant on every railway embankment. Plants may possess more than one species of parasite; on the colt's-foot there also occurs a species of *Coleosporium*, and nearly a score of different fungi are stated to take up their quarters on the leaves of the nettle. Each species of æcidium confines itself, as a rule, however, to plants of a particular family, or even selects its hosts from a single species; thus the æcidia of the berberry,

hawthorn, honeysuckle, Scotch fir, mountain ash, anemone, buttercup, nettle, primrose, violet, willow-herb, bedstraw, dock, and many other plants are all different and belong to distinct species. Seen with the lens the cluster-cups present the appearance of a group of miniature volcanoes. At first the æcidium fruit is a small spherical body formed beneath the epidermis of the leaf whereon it grows, which it ultimately ruptures; the æcidium itself, when ripe, bursts, and the yellow spores are discharged. The section of an æcidium shows a cup-like cavity with spores arranged in vertical rows like short strings of beads; they are developed by budding, and become detached in succession. Externally the aecidium is in most species invested by a membranous envelope, the peridium, usually cup-shaped, but occasionally, as in the cluster-cups of the pine, prolonged into a tube. The peridium may open irregularly or split up in a definite manner, giving its margin a toothed appearance. An aecidiospore can germinate when sown on a suitable host. The cluster-cups appear earlier in the season than the uredo- or telutospores, and are very often associated with smaller cups called spermogonia, which appear on the upper surface of the leaf (fig. 5, a spm.), from which issue minute spermatia, which have never been known to germinate, and are therefore generally regarded as male reproductive cells.

All the three kinds of spores above described, it must now be explained, are produced in succession by some of the Uredines on the same mycelium. The Puccinias of the mint, primrose, violet, goat's-beard, and onion develop all three forms; teluto- uredo- and aecidiospores occur on the same plant. Had we examined the bramble *Phragmidium* earlier in the season we should have found, not the many-celled telutospores, but unicellular uredo- or aecidiospores. The rose rust, *Ph. subcorticum*, and that of the barren strawberry, *Ph. fragariae*, in like

manner bear three kinds of spore on the same host. The rusts of the knot-grass, beet, geranium, and valerian, caused by species of *Uromyces*, also possess spores of three kinds. Others, like *U. alchemillæ* and *U. rumicis*, have teluto and uredo but no aecidiospores. Only telutospores are known to be produced by the *Puccinias* parasitic on the gout-weed, speedwell, mallow, harebell, and



DESCRIPTION OF THE FIGURES.

1. Telutospores: a, *Phragmidium violaceum*; b, *Puccinia menthæ*; *P. violarum*; d, *P. graminis*. 2. Germinating telutospores with promycelia and sporidia: a, *Phragmidium*; b, *Triphragmidium*. 3. Uredospores: a, grass blade with rust; b, spores of bramble rust; c, spores of barren strawberry; d, e, spores of corn rust; f, of rose rust; g, of thistle rust. 4. *Æcidia*: a, leaf of berberry with cluster cups; b, side view of *æcidia*; c, leaf of sun-spurge spotted with *Melampsora*; d, cluster cups of bedstraw. 5. *Sporangia* on upper surface of leaf.

saxafrage. Uredospores are wanting in the *Puccinias* of the ragwort and earth-nut; telutospores are absent in the rusts of the figwort and fern, while neither the uredo nor telutospores are known which correspond with the *æcidia* of honeysuckle, meadow-rue, and gooseberry. The three kinds of spore are not formed simultaneously; further observations may therefore be expected to reduce the number of these exceptions. Before it was known

that a cluster-cup, a rust, and a brand might be merely successive stages of the same fungus, specific names had been assigned to each of the forms, with the result that some of these parasites have three names; and this inconvenience is still unavoidable in cases where the connection between the different stages has not yet been demonstrated.

But what invests this group of fungi with peculiar interest is the fact that many of them spend their first or aecidium-bearing stage on a different species of host-plant from that which they inhabit at a later period of their life history, when they develop uredo- and teluto-spores. Thus there are several kinds which produce aecidia on the leaves of firs and pines, and then migrate to plants of the Heath order. To this changing of hosts the name Heterœcism (*heter*, "other"; *oikos*, "house") has been given. Analogous phenomena are observed among animal parasites. The same organism which occasions "measles" in pork, causes the tapeworm in man while in the cat it is but a more advanced form of one that inhabits the intestines of the mouse; and the liver fluke of the sheep passes one part of the cycle of its development in the body of a pond snail. Farmers long suspected that the presence of berberry bushes in their hedges had something to do with the rust that destroyed their wheat. This idea was verified by the discovery that *Puccinia graminis* is merely a later stage in the development of *Aecidium berberidis* which infests the berberry. As the alternation of generations was first traced in this species, it is the example of heterœcism usually given in text-books, but a similar connection has been made out in many other instances. The cluster-cups of the Scotch fir belong to the same Uredine which bears teluto and uredospores on the groundsel; those of the colt's-foot correspond to telutospores on the meadow grass of *Puccinia poarum*: *Aecidium urticæ* of the nettle devel-

opes uredospores on species of *Carex*; the aecidium fruits of *Gymnosporangium cancellata* occur only on the leaves of the mountain ash and other Pomaceae, the telutospores only upon those of species of juniper. The aecidium of the buckthorn is related in the same way to *Puccinia coronata*, not uncommon on grasses. Again, the aecidia of the orchid, onion, dock; and dandelion appear in their uredo forms on various grasses and sedges, while the parasites of certain Composites seem to migrate to other plants of the same order. The corn rust, *P. rubigo vera*, turns out to be the second stage of an aecidium that grows on the leaves of *Anchusa* and other plants of the borage family.

From these examples it will be seen that in fungi of this description each generation of each species has its own form of fructification and its own peculiar host-plant. The brands of the mint and bramble are not heteroecious, but produce all three sorts of spore on the same host, or even on the same mycelium; the Uredines of the honey-suckle, meadow-rue, and gooseberry, of which only the aecidium forms are known, are likewise restricted to one species of host. In this country *Æ. grossularia* only produces aecidiospores; telutospores are stated to have been observed on the gooseberry itself on the Continent. Should this be confirmed, it would appear that the fungus in question is confined during its whole existence to to the same plant, and does not, therefore, possess the heteroecismal character.

In the life history of one of these migratory fungi we have then the following phases:—The earliest form inhabits the leaves of a plant such as the berberry, where it exhausts its energies and completes its career by the production and discharge of the aecidiospores; the latter are incapable of germinating on the berberry, but on being transferred to wheat, at once germinate and form a mycelium which develops the uredo and telutospores.

The uredospores continue to propagate the uredo form of the fungus indefinitely upon the wheat, but the telutospores or sporidia arising from them will only grow mycelia if sown on the leaves of the berberry.

In not a few instances these relationships have been established by direct experiment. Dr. C. B. Plowright succeeded in producing aecidia on the hawthorn and mountain ash by infecting their leaves with telutospores taken from the juniper, and on the nettle with telutospores from a species of *Carex*. Conversely, with aecidiospores from the nettle he obtained the uredospores of *Puccinia caricis* on *Carex*, and spores from the colt's-foot cluster-cup placed on the meadow grass developed the uredo form of *P. porarum*. The aecidium of the berberry gave rise to *P. graminis* on grass, and berberry leaves infected with telutospores from the latter developed aecidia of the usual form. Check plants which in these experiments were not inoculated yielded negative results; the possibility of error was thus eliminated. It may therefore be taken as conclusively proved that many of these leaf fungi exist in alternate generations as parasites on distinct plants, with forms so unlike that the successive phases in the life cycle of one and the same fungus were long regarded as different species and classified in separate families. The brilliant orange and scarlet tints exhibited by so many Uredines are due to the presence in their cells of drops of highly-coloured oil. They differ from the Peronosporæ in their septate mycelium, and are less destructive, as the mycelium does not extend through the entire body of the host, but the damage is usually restricted to the small affected areas of the leaf. Sexual reproduction has not been observed in the Uredines; there are, however, grounds for the belief that a process of fertilization really takes place, but the consideration of this question must be reserved for another occasion.—*Knowledge*.

The Dennis Fluorometer.

WITH FRONTIS-PIECE.

It is the function of this instrument to establish, with precision, the location of any foreign object within the human organism which is impermeable or comparatively impermeable to the X-rays. In other words it is the province of the fluorometer to enable observers to form an exact and certain diagnosis in cases of presence of coins, bullets, needles, calculi or any other substance which is comparatively more dense in its fluoroscopic shadow than the subject in which it is contained. It is also its function, by eliminating the distortion of position, and the distortion caused by the divergence of the rays, to provide the surgeon with absolute and reliable measurements in cases of dislocations, fractures or any abnormal conditions of the anatomy which are susceptible of reproduction in the Roentgen shadow. To obtain a correct shadow with a view to locating an object after the parallelism of the rays is accomplished, it is absolutely necessary to have a base for measurement.

To accomplish its results, it provides: A shadow of the body or limb, is thrown on the field of the fluoroscope or, on the sensitive plate, at the same time giving data which will not only enable us to make measurements but to reproduce the exact position of the body or limb. It eliminates the distortion resulting from the radiation of the force or energy known as the X ray. The distortion caused by the position of the subject or by the radiation of the energy, having been eliminated, it provides an accurate cross-section of the body or limb, and supplies an absolutely correct right-angle, at the intersection of the lines of which the foreign object will be found in the body or limb.

The fluorometer consists in a set of carefully designed metallic angle pieces, which conform generally to the shape of the body or limb, and which are susceptible of

being squared with a simple and conveniently adjustable table. When the proper position of the cross-section is obtained, the two arms of the fluorometer will present the characteristic single shadow on the field of the fluoroscope.

Attachable to the arms of the fluorometer are two pins or sights. By means of these sights, the foreign object having been brought in line with them and the proper adjustment having been made, a correct line is produced, with the sights and foreign object coincident. By means of a metallic grating, of inch mesh, which is placed adjacent to one side of the body and consequently one side of the fluorometer, exact measurements can be made with the eye from the base line, and from points on the circumference of the body, to the foreign object.

Then, without moving the body or the fluorometer, the Crookes tube is placed directly over the subject for the purpose of obtaining the vertical line. By means of an adjustable cross-piece, which is placed over the arms, exactly the same results in a vertical way are obtained by viewing the subject from beneath, the same condition of parallelism having been produced, another set of pins having been placed in position.

While the first operation locates the foreign object on an exact cross-section, the second observation shows the exact position occupied by the foreign object in that cross section. All the elements of distortion having been eliminated, the foreign body will necessarily be at the intersection of the two lines of the right angle. The first cross-section obtained is shown by a line of India ink or iodine on the body.

Very early in the history of the X-ray it was found that it was a very deceptive guide, and that, wherever a foreign substance which was less permeable than its surroundings might be, it was certainly not in the position indicated by the so-called radiographs or skia-

graphs, and, as a consequence, two views taken at right angles, would not disclose the location of the object. It was at once apparent that the visible effect of the Roentgen ray, whether in its action on a sensitive plate or paper, or its visual effect on the fluorescent screen, is a shadow only. It must be remembered that we are dealing with a shadow, which is not only treacherous, but is lacking in the dimension of thickness. When the X ray once starts it goes straight to infinity. Thus it has happened in many cases that, while apparently a bullet or needle, for instance, was located in a certain position with reference to the anatomy, as shown by a skiagraph, it would be found that it was not at the place indicated. It is not necessary to enlarge upon this branch of the distortion, for it is familiar not only to every experimenter on the lines of the Roentgen rays, but to every surgeon who has made a skiagraph the basis of exploration.

The only practical solution of the difficulty is to establish a definite cross section of the patient by means of angle pieces, which would be less permeable than any portion of the subject, and which could be made to retain their relative position to the subject, and with the parallelism of the rays through the process of producing the angles. Having established this cross-section, it was found that it was desirable that it should be formed in close proximity to the foreign object, which had been superficially located by means of the fluoroscope. An appliance was perfected which conforms in a general way to the shape of the body, the neck, the head, the foot or the limb, and which at the same time preserves the position of the body squarely in its relation with an adjustable table. This adjustable table is extremely simple, and is so arranged that when the patient is placed in the position desired, the fluorometer will rest in a groove on the table, in one case, and an attachment of the table in the other. Then the desired position having thus been

obtained and secured, as shown in the illustration, patient and fluorometer are quickly brought into such a



position relatively to the source of energy that it shows only a thin, characteristic line on the field of the fluoroscope. Now, if a line of India ink is drawn between the

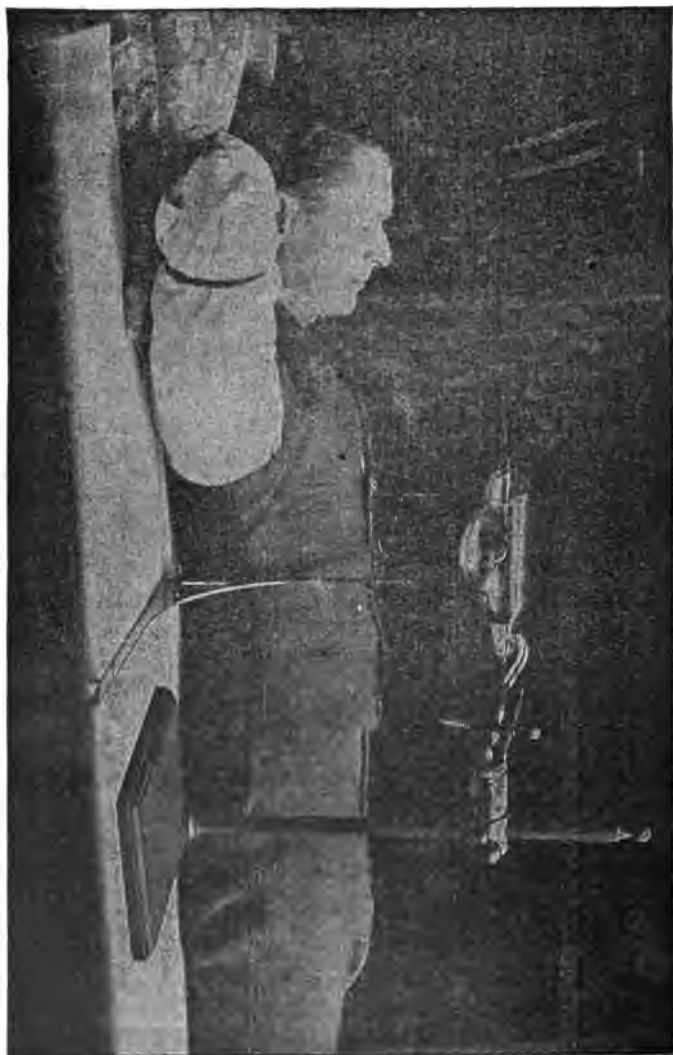
arms of the fluorometer on the subject, the exact cross-section of the patient, as shown on the fluoroscope, will be made manifest. If, therefore, the cross-section is established very close to the foreign object, it will be seen at once that the first difficulty has been surmounted; the object has been located in close juxtaposition to a thin cross-section of the body or limb.

Attachable to the table is a metallic grating with meshes of exactly one inch. This grating, when in position, is also square with reference to the table upon which the patient is placed, and the normal position is close to the side of the patient, opposite to the source of energy. The fluoroscope is placed against this grating, and it will be seen at once that measuring from any point desirable, on the surface of the patient to the foreign object, is but the matter of a moment. Just here two movable pins on the arms of the fluorometer appliance come into use. These pins are placed equidistant from the base of the fluorometer (which is, of course, squared with the table). Then when the table, with its patient, is adjusted, so that the pins or "sights" coincide with the foreign object, it will be known that all three are in the parallelism of the rays, and that the characteristic distortion, caused by the angle of the rays, has been eliminated. Measurements, taken with the eye by means of a metallic grating, will thus enable the surgeon to chart unerringly the position of the object with reference to the surface of the body which contains it.

How far "in" from the surface of the body it may be, however, is, at this point, a mystery. Now, without moving the patient or disturbing the position of the fluorometer, the second observation is taken.

For convenience in using the fluoroscope, a section of the top of the table is removable, and a proper fluorometric appliance substituted, by means of which the second right line of the right angle is determined. This

aperture in the table is also provided with the metallic grating, and the fluorometer is provided with an attach-



ment which closes the side of the instrument which was open during the first observation. Now, when the surgeon takes a position below the table, he obtains a view

which is exactly at right angles with the first. The pins are again brought into use, and the table, patient and fluorometer, together, brought into parallelism with the rays, the tube having now been placed over the patient, as shown on the opposite page, instead of the side. The position of the foreign object again, with reference to the points on the cross-section of the subject and with reference to certain points on the fluorometer, is at once charted by the aid of the meshes of the metallic grating.

Necessarily, the foreign object must be situated at the point where the two lines coincide, the distortion caused by position, also the distortion caused by the angle of the ray having been eliminate. Where that point is, can, of course, be at once ascertained by measurment on the surface of the body.

In the case of a bullet in the brain cavity elements of uncertainty of location, having in view the desirability of a possible operation for its removal, become very grave. A very slight variation of the position occupied by the head will produce a distortion which would preclude successful exploration. By means of the fluorometer the position of a foreign object in the brain cavity is ascertained with precision exactly as in the case of the body already given: it becomes merely a matter of cross-sections and surface measurements.

In the case of a bullet in the shoulder there is the possible difficulty of distinguishing a foreign object by examining the shadow thrown transversely to the body. With this system, however, the difficulty vanishes. Baring the shoulder, the appliance is fixed directly over the center of the foreign object, it having been disclosed by superficial view. The body is then brought into such a position that the appliance shows only the characteristic thin vertical line on the field of the fluoroscope. A line of India ink is then drawn across the shoulders to indicate the cross-section obtained. Then removing the

appliance and moving the shoulder slightly, perhaps an inch, the instrument is placed directly over the foreign



substance and brought within the parallelism of the rays. Again the India ink brush is brought into requisition and another cross-section indicated, intersecting the other at some point on the surface.

At this juncture, the metallic grating is brought into use. At the point where the two lines intersect is placed a bit of metal. Then with the grating the distance down to the point occupied by the foreign substance, which is necessarily directly under, the point of intersection is measured, the line being projected parallel with the base line of the fluorometer.

The Sporular Development of the *Amoeba Villosa*.

BY J. C. SMITH,

NEW ORLEANS, LA.

[Read before the A. M. Society, 1897.]

In April, 1897, the writer secured some decayed leaves from a pond in the Audubon park in New Orleans, and on scraping a portion from one of the leaves, placed it under a cover-glass, and then examining it with a $\frac{1}{4}$ inch objective, the field was seen to be filled with a number of *Amoeba villosa*, Leidy. Some of the specimens were active, some were apparently on the threshold of encystment, while others had already entered that state. The field, fortunately, was entirely free from other forms of *Amoeba* as well as of the troublesome *Paramoecium*.

For awhile the field was thoroughly examined, and the writer noticing something unusual about the *Amoeba*, concentrated his attention on one of the forms that had become quiet, and evidently about to become encysted. This specimen measured 1-125 inch, displayed the posterior well covered with the villous processes which are diagnostic of this species. The endoplasm contained a number of linear bodies and some food-balls already changed in color. The contractile vesicle was large and active, and instead of the usual nucleus, there were from ten to fifteen nuclear looking bodies that moved freely in the endoplasm in unison with a slight contraction and expansion of the body. These nuclear looking bodies were evenly dis-

persed, of a bluish tint, globular, very granular and in size varied from 1-2750 to 1-1800 inch. The slight contraction of the body became fainter, and in about one hour there was a rapid movement of the contents of this specimen, to the posterior extremity, and at the same time a rupture of the seemingly dense ectoplasm of this part. A number of the nuclear looking bodies, in company with the linear bodies and food-balls were ejected from the body with considerable force, sending them a distance from the body equalling one-half of its long diameter. The Amœba now seemed to collapse and the contractile vesicle disappeared.

My attention was now confined to the nuclear-looking bodies that lay scattered about. In the course of a few minutes, the granules contained in these bodies became partially concentrated in one place in contact with the ectoplasm, and was of a deeper blue in color. This concentration of the granules left more than one-half of each body almost clear and transparent, and in this clear space there appeared simultaneously with the concentration, a very minute but distinct pulsating vesicle. In a short while a slight movement of the body was detected and there appeared a flagellum equalling in length from four to five of the body's diameters and was directed stiffly forward. The body now became very active and in a few seconds darted off in a rapid chase about the field, in an aimless manner, reminding the writer of the zoospores of the *Achlya prolifera*.

Casting a glance at the other free nuclear-looking bodies, it was seen that most of them were undergoing the same change, and they were kept under observation until they had all disappeared from the field, in the same manner. It was impossible to follow any one of these zoospores, as the field had become filled with them.

The writer now confined his attention to one of the encysted Amœba. The one selected measured 1-250

inch, possessed no trace of a contractile vesicle, no food-balls, a few of the linear bodies, some of the nuclear-looking bodies and nothing that could be differentiated as the original nucleus. The nuclear-looking bodies were granular, as the ones cited above, and instead of being free in the endoplasm, were congregated in five spherical masses, each mass being composed of from four to six units and was enclosed in a very distinct membrane, which was made even more distinct by adherent granules.

In a short while and without any apparent movement of the body, three of these spherical masses were thrown out with some force; the fissure in the ectoplasm of the encysted amœba was not closed; and the whole form collapsed, still containing two of the masses. In about fifteen minutes after being ejected, the membranous coverings of the units were ruptured and the contained nuclear-looking bodies were freed. The average size and appearance of these bodies were the same as the ones seen discharged from the amœba first recorded. In the course of a few minutes they were seen to go through identically the same phenomena as was observed to take place with the one first mentioned. The field was now filled with these zoospores, and being free from all other forms of life, offered a good opportunity for further study.

In about three hours after beginning the observation, some of the zoospores had slackened their movements, would come to a halt for a short while, and then start off again; a number were less active than the rest and in a short while became quiescent. Selecting a quiet specimen that measured 1-2000 inch and using a β objective it could be distinctly seen to elongate itself and then resume its original size; would throw out a single minute lobate process now from one side and again from the other side. The dark blue mass of aggregated granules first observed in the nuclear-looking bodies after they had been ejected from the amœba, had become

much smaller and now represented the nucleus itself. The contractile vesicle was very distinct and the intervals between diastole and systole were short. This extrusion of lobate processes was witnessed for some time, and it was noticed that there was no change in the position of the young amœba, but that after awhile it retained the elongate form and would throw out pseudopodia from all parts of its body, that would at times, exceed the length of the zooid. At these times it had the appearance of a minute *Amœba proteus*, many of the forms now measured as much as 1-900 inch, without the pseudopodia. The hour being late, the slide was carefully prepared and put away with a view to continuing the observation later.

On again resuming the observation, nineteen hours afterwards, the field was found strewn with a very large number of small and active *Amœba* that differed from the larger forms of *Amœba villosa* only in the absence of the villous processes. The endoplasm was slightly granular, the nuclei and contractile vesicles as distinct as in the large forms. They were freely moving about and extruded only the lobate processes. Measurements showed them to range from 1-800 to 1-550 inch. In two places on the slide were a number of forms, from ten to fifteen, closely huddled together, as if dropped in a mass at that place. In size and shape they were the same as the free moving ones; the nuclei, contractile vesicles and anterior clear spaces being exceedingly distinct. They had a slight movement on and alongside of each other, without seeming to increase the space occupied by them. They would remind one of a litter of kittens a day or two old. In speculating on this phenomenon, one could come to the conclusion that those nuclear-looking bodies that remained in the *Amœba* after a part had been ejected, were developed within the confines of the body, and were freed only after the dissolution of the firm ecto-

plasm, and in this way the clusters of amœba were produced. The slide was now again laid aside, and on again resuming the observations eighteen hours after, very few forms were found, and they differed in no way from the forms seen the evening before. If food could have been supplied the observation could perhaps have been extended so as to witness the full development of these young forms.

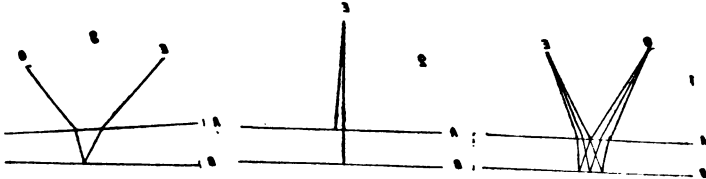
To make this history of the sporular development of the *Amœba villosa* (and by inference all amœba) complete, there is only one essential requisite, and that is to trace the origin of the nuclear-looking bodies to the nucleus.

Multiple Images in Mirrors.

By WM. BALFOUR STOKES.

(Read before the Quekett Club, December 18th, 1896.)

The origin of multiple images in plate-glass mirrors, and their behaviour, seems to have attracted but little



notice among microscopists. They have been noted, and a partial remedy has been prescribed, but their origin seems to have been either too simple or too complex for explanation.

When attention has been called to these images, simple, and I believe efficient, reasons have been given; but their authors did not explain the behaviour of the images when the mirror is revolved.

A figure will best show my own ideas as to their origin. In Fig. 1, A is the glass surface, B the silver surface, O the object, and E the eye.

In the direction 1, 2, 3, appear the first three images. No. 1 is from the glass surface, No. 2 is from the silver surface, and No. 3 is from the silver and *air* surfaces.

Move a card along A towards 1, and No. 3 disappears first, No. 2 immediately after, and No. 1 when the card reaches that point. So much for their origin.

It will be asked, perhaps, how the images can alter their position when the mirror is revolved in the plane of A. They cannot. The mirror A B has parallel surfaces. Microscope mirrors and most plate-glass mirrors are not parallelised, but are, at the best, "optically" flattened, and may be regarded as wedges.

It is then easily seen how images approximate and retire when the mirror is revolved.

Let us give surfaces A and B an inclination of 1° (Fig. 2). Then viewing a small object at E (close to the eye) one image appears towards 1, *i.e.*, at right angles to A, and another in the direction E 2— $1\frac{1}{2}^\circ$ from E 1, which, after being refracted to 1° in the glass, is reflected at right angles from surface B.

There is another image nearer the letter A, but, as it follows the same laws apparently as the others, save that it is a real double reflection, we need not consider it. If this mirror is revolved in the plane of A, of course No. 1 image will remain still. No. 2 and subsequent images will revolve with the mirror round No. 1. If we exaggerate this wedge shape of our mirror, we can see that at a peculiar angle these images can be made to superimpose. Let the signs be as before (Fig. 3) and the images whose rays pass respectively from O to 1 and 2' will be reflected to E as one image. I should imagine the third image to arrive at E through 1, but I have not yet worked this out. Of course, placing the eye at O and the object at E would be equivalent to revolving the mirror. The images vary slightly in size owing to their various distances.

No. 2 is the brightest except at great obliquity.

EDITORIAL.

Formaldehyde.—The credit of the discovery of the powerful antiseptic properties of formaldehyde and its practical application is due to A. Frillat, who in 1888 first noticed its preserving action on samples of wine, and in 1891 made public his experiments, showing it to possess antiseptic properties much superior to all non-toxic organic antiseptics then known.

Typhoid Fever.—Water drawn from an abandoned well has given rise to several cases of typhoid fever near Rye Beach, N. Y. A party consisting of half a dozen persons went into camp near that place and drank water from it. The whole party immediately became ill, and two of the members have since died.

Fire-Blight.—This is now supposed to be due to a bacterium which enters the plant through the tender parts of the tissue, like the flower-buds or young leaf-buds as they unfold, and spreads down through the branches. When it appears on the main branches it is often called "body blight," and its presence is marked by brown and lifeless patches which become sunken. Wherever the blight appears the limbs should be cut off at once below the point where the infection has reached, and as a precaution against the spread of the disease the prunings should be burned.

MICROSCOPICAL APPARATUS.

The Micromotoscope—Is a kinetoscope for photographing cell life in motion, as seen in the microscopic field. The pictures are taken by the gelatine film at from 5,000 to 15,000 magnifications, at the rate of from 1,600 to 3,500 per minute. The images being magnified thousands of times when projected upon a screen, the views of some of the families of microbes are very realistic. It has been learned that some of them act as if intelligent. The photographs of the blood in circulation in the thinnest part of the ears and webs of the fingers, showing the capillary

and arterial motion and the changes going on in the white cells, are of great interest. They indicate something of the nature of life and disease. The stream of circulating human blood is so swift that the eye cannot keep pace with it, and the changes in the white blood cells are correspondingly rapid. Some of the pictures show a white cell on the fast moving stream, like a white cap on the sea, constantly changing its shape. It throws out or takes in its arms like an octopus, seizing the microbes in its path. In disease this movement of the arms takes place with much less energy than in health. These pictures cannot fail to be of great value in the study of diseases. The micromotoscope will greatly aid in the investigation of phenomena of action of ameboid life in water.—*Elect. Age*.

MICROSCOPICAL MANIPULATION.

Mounting Chara.—A. Flatters finds that the fruit of chara makes a good slide when mounted in glycerin jelly. After cleaning he places it in 92 per cent alcohol for several hours, then transfers into a mixture of equal parts of spirit and glycerin for several hours longer, after which he pours off nearly all of the mixture and adds pure glycerin at intervals till the glycerin becomes concentrated. Finally the object is mounted in glycerin jelly in a cavity slip just deep enough to take it without pressure. A second method is to mount in balsam, as follows:—After cleaning, graduate through 25 per cent, 50 per cent, to 92 percent alcohol and allow to stand in the last strength for several hours. Take a tube and put in it oil of cloves. On the top of the oil pour a little absolute alcohol. Immerse the specimen gently in the alcohol and allow it to sink to the bottom of the tube. When clear mount in balsam and benzole. If transferred direct from the spirit into oil of cloves, objects will shrivel and be spoiled, hence the necessity of the graduating method. To see the antheridia properly, sections should be made.—*Science Gossip*, iv., 88.

Vegetable Sections.—The best results are obtained by first bleaching the tissues, and the best agent for this pur-

pose is Labarrouque's solution (liquor sodæ chlorinata) of the U. S. P. Put the sections in the liquor and leave until every trace of color is removed. The time will vary according to the nature of the tissue, thickness of section, etc. When bleached, wash the sections by allowing a gentle stream of water to flow over them until they no longer smell of the liquor, then put them in distilled water carrying one minim of nitric acid, c. p., to the ounce. Let remain for a few moments, then transfer to absolute alcohol where they should remain one hour, before passing to the staining baths. Except for special demonstrations where carmine, picro carmine, xanthoxylin, etc., are required, the writer prefers the aniline colors.

BACTERIOLOGY.

A Sweet Corn Bacillus.—Mr. F. C. Stewart, is studying a new bacterial disease of sweet corn. The plants wilt and dry up, although the leaves do not roll as they do when they die from lack of moisture. In young plants death occurs in a few days, but the disease requires from two to four weeks to run its course in older plants. Externally affected plants appear sound, but when split the fibro-vascular bundles are found gorged with a yellow substance. When a diseased stalk is cut crosswise there exudes from the ends in yellow viscid drops a substance composed of immense numbers of short bacilli. The disease may attack the plants at any stage of growth, but is the most virulent about the time when the ears are forming. It does not spread from an initial centre, but is found scattered through the field. Diseased plants frequently occur in the same hill with healthy ones. It is found in all kinds of soil, and seems to prefer the early dwarf varieties of sweet corn.—*Garden and Forest*.

Flavoring Micrococcus of Butter.—It was a remarkable discovery, when, in April, 1896, Simeon C. Keith was studying the effects of various bacteria upon cream, and in the course of his experiments he isolated a micrococcus that was found to produce a decided butter flavor and aro-

ma when grown in milk or cream. This proved to be a new species, for which he proposed the name *Micrococcus butyri-aromafaciens*.

It has always been the custom to allow cream to sour or "ripen" before churning it for butter, because after this process the butter comes better and more quickly, is of better texture and flavor, and keeps better than butter made from sweet cream. Lord Lister and Pasteur, many years ago, showed that the souring of milk and cream is due to minute micro-organisms. It remained for Professor Vilhelm Storch, of Copenhagen, however, to introduce the use of pure cultures of milk-souring bacteria in butter making. Storch isolated three species that impart especially fine flavors to butter.

A similar line of work was taken up by Professor Weigmann, at Kiel, in Germany, and by Professor H. W. Conn, of Wesleyan University, in the United States.

Of the bacteria that have been described as producing a beneficial effect in the ripening of cream, *Micrococcus butyri-aromafaciens* most nearly resembles Conn's *Bacillus* No. 41 in its effects upon milk, but it differs in its morphological and in many of its physiological characters. It is a micrococcus growing at 37 degrees and 20 degrees C. It liquefies gelatin slowly, and does not grow well on potato. Recent cultures on gelatin seem to show that the organism has lost to a considerable extent its power to liquefy gelatin during a year's cultivation.

The culture of the micrococcus for use in creameries is propagated in bouillon in Fernbach flasks (broad flasks so constructed that a large surface of liquid is presented to the air). When ready for shipment, the culture is transferred to sterilized bottles under aseptic conditions and hermetically sealed by means of sterilized corks and melted paraffin. Put up in this way, the culture may be kept for an indefinite time without danger of infection by any other organism, but in the sealed bottles the micrococcus loses its vitality so rapidly that after eight days it will no longer produce the best results. Experiments made on a commercial scale show that cream ripened with the aid of

fresh, pure cultures of this organism produces generally better butter than the same cream ripened in the usual way.

The general characters are these: A micrococcus occurring generally in pairs; 0.5 to 0.7 thousandth of a millimeter in diameter, occasionally reaching 1; non-motile; no spores; grows rapidly at 37 degrees and 20 degrees C.; aerobic; slow liquefier of gelatin; non-chromogenic(white); stains well with carbol-fuchsin.—*Popular Scienc News*.

The Bacillus Icteroides.—Is a small rod with rounded ends, united by pairs in cultures, from two to four millimeters in length, being three times as long as broad. It grows readily in all the ordinary culture media, and is easily stained by the usual solutions used for such purposes. "When the colonies are grown in the incubator they do not present marked differences from other species of microbes; they are rounded, of a slightly iridescent gray color, transparent, even in surface, and regular in outline. But if the colonies are allowed to evolve at a temperature of 20 degrees, to 22 degrees C., they look like drops of milk, opaque, projecting, and with pearly reflections." By exposing cultures for twelve hours in an incubator and then to the temperature of the air for the same length of time, they show themselves as constructed with a flat nucleus, transparent and azure, with a prominent peripheral circle that is opaque. This, the discoverer claims will distinguish the bacillus from all previously known varieties. "It is a facultative anaerobe; ferments glucose and saccharose; very resistant to drying; dies in water at 60 degrees, or after exposure to sunlight for seven hours, and lives for a long time in salt water."

Microbe of Ambergris.—According to professor Beau regard, the intestinal concretions of the cachalot are caused by a microbe very similar to the comma bacillus of cholera. Here is a new field for the enterprising pharmacist; he might inoculate a few sperm whales in confinement and patiently await the formation of the calculi. The difficulty is, as usual, first to catch the cachalot.

MEDICAL MICROSCOPY.

Yellow Fever.—Walter Barker, U. S. Consul at Sagua la Grande, Cuba, reports to Surgeon General Wyman, that two of the five warehouses used for storing sugar before shipment to the United States are being used as hospitals for yellow fever and other infectious diseases among Spanish soldiers.

Typhoid Fever.—The serum test of typhoid fever has been applied to the detection of typhoid infection in water by Dr. Waytt Johnson, of Montreal, bacteriologist to the Provincial Board of Health, who has described his methods and promising results before the Montreal Medico-Chirurgical Society.

MICROSCOPICAL NOTES.

It is difficult to freeze a germ to death; but boiling quickly destroys all micro-organisms.

Make it your business to get rid of the soil where germs may grow, and the germs will seek other pastures.

Antiseptics are excellent remedies for some one else to rely upon. Better is hot water and plenty of good soap and sapolio than a solution of bichloride of mercury or carbolic acid.

Professor Virchow, has been elected a foreign associate of the Paris Academy of Sciences in the place of the late Dr. Tchebitchef.

The Prussian government will assist the fresh-water biological station at Plon after October, 1898.

Pasteur.—September, 29, 1897, was the second anniversary of Pasteur's death, and it was fittingly remembered at the Institute.

Sanitation.—A proprietor of a barber shop has very justly been fined £ 5 and costs for attending to his business while still passing through the peeling stage of scarlet fever.

THE AMERICAN

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PUBLICATION ANNOUNCEMENT.

The Journal will in 1898 be a 16-pp. illustrated magazine and confined very carefully to the subject of microscopy, omitting the "contributions to biology." No long articles can be accepted. Abstracts, news, and brief articles will be sought. Papers on the subject are scattered widely as is shown by our exchanges. A great number of short items and abstracts of articles will be possible. The price of subscription will be restored to one dollar.

The publication of "The Microscope" will be discontinued with this issue and its subscription list turned over to the American Monthly Microscopical Journal. That magazine will be supplied to all those who have been its subscribers. Those who have taken both periodicals will receive the Journal only unless they by post card or otherwise request a discontinuance. We shall treat all our exchanges in the same way.

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